SOIL SURVEY OF

Shiawassee County, Michigan

United States Department of Agriculture
Soil Conservation Service
In cooperation with
Michigan Agricultural Experiment Station

Issued June 1974

Major fieldwork for this soil survey was done in the period 1958–63. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1963. This survey was made cooperatively by the Soil Conservation Service and the Michigan Agricultural Experiment Station. It is part of the technical assistance furnished to the Shiawassee County Soil Conservation District.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Shiawassee County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information in the survey. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, woodland suitability group, and recreation group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units.

Foresters and others can refer to the section "Woodland," where the soils of the county are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Wildlife."

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the sections "Recreation" and "Residential Development."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers to the county may be especially interested in the section "General Soil Map," where broad patterns of soils are described.

Cover: The Conover and Brookston soils are well suited to farming, the main enterprise in Shiawassee County. About 84 percent of the county is used for farming.

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Washington, D.C. 20402

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SOIL SURVEY OF SHIAWASSEE COUNTY, MICHIGAN

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UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE MICHIGAN AGRICULTURAL EXPERIMENT STATION

SHIAWASSEE COUNTY is in the southeastern part of Michigan within 50 miles of the cities of Flint, Lansing, Pontiac, and Saginaw (fig. 1). Corunna, the county seat, is near the center of the county. The county has an area of 345,600 acres, or about 540 square miles.

Figure 1.—**Location of Shiawassee County in Michigan.**

Farming is the main enterprise in the county. The climate is favorable for cash-grain and livestock farming. The major crops are soybeans, corn, field beans, wheat, and alfalfa. Small industries are located throughout the county. Many residents of the county are employed by the automobile industry in adjoining cities.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Shiawassee County, where they are located, and how they can be used. They went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The soil series and the soil phase are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Boyer and Miami, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Boyer loamy sand, 0 to 2 percent slopes, is one of several phases within the Boyer series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woods, buildings, field borders, trees, and other details that help in drawing boundaries accurately.

The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Shiawassee County: the soil complex and the undifferentiated group.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Owosso-Miami sandy loams, 2 to 6 percent slopes, is an example.

An undifferentiated group is made up of two or more soils that could be delineated individually but are shown as one unit because, for the purpose of the soil survey, there is little value in separating them. The pattern and proportion of soils are not uniform. An area shown on the map may be made up of only one of the dominant soils, or of two or more. The name of an undifferentiated group consists of the names of the dominant soils, joined by "and." Eel, Landes, and Abscota soils is an example.

In most areas surveyed there are places where the soil material is so rocky or so shallow or has been so drastically altered by man that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Made land is a land type in Shiawassee County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others; then they adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Shiawassee County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The seven soil associations in Shiawassee County are discussed in the following pages.

The term for texture used in the descriptive heading for each association applies to the surface layer. For example, in the descriptive heading for association 1, "loamy" refers to the texture of the surface layer.

1. Brookston-Berville-Conover association

Poorly drained and somewhat poorly drained, nearly level, loamy soils on till plains

This association consists mainly of flat to slightly undulating plains. Long, low beach ridges are common in many areas. These ridges are oriented in an east-west direction, are 50 to 200 feet wide, and rise 10 to 15 feet above the plains. Small areas of gently sloping to steep soils are along drainageways and streams.

This association occupies about 12 percent of the county. About 40 percent is made up of Brookston soils, 25 percent of Berville soils, 15 percent of Conover soils, and 20 percent of minor soils.

Brookston soils are poorly drained. Their surface layer is very dark brown loam about 13 inches thick. The subsoil is light brownish-gray and grayish-brown clay loam. Light brownish-gray heavy loam begins at a depth of about 42 inches.

Berville soils are poorly drained. Their surface layer is very dark brown loam about 10 inches thick. The subsoil is light brownish-gray loam and gravelly sandy clay loam, and grayish-brown gravelly light clay loam. Brown light clay loam begins at a depth of about 37 inches.

Conover soils are on slightly higher parts of the landscape. They are somewhat poorly drained. Their surface layer is very dark gray loam about 9 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is light brownish-gray and pale-brown clay loam.

Light brownish-gray loam begins at a depth of about 36 inches.

The minor soils of this association are those of the Iosco series, the deep variant of the Iosco series, and the Mancelona, Menominee, Belding, and Newaygo series. These soils occupy mainly low beach ridges.

This association is well suited to corn, beans, small grains, and forage crops. Fertility and available water capacity are high. The main concern of management is removing excess water.

Most of the acreage is used for cash crops, but a few small wooded areas are used for wildlife habitat. The soils on beach ridges are well suited to small fruits and orchard fruits.

Most of this association has moderate to severe limitations for nonfarm uses. The well-drained soils on beach ridges have slight limitations for most nonfarm uses.

2. *Conover-Brookston association*

Somewhat poorly drained and poorly drained, nearly level to gently sloping, loamy soils on till plains

This association consists of flat to gently undulating areas dissected by drainageways; broad, flat depressional areas; and swells and small valleys that have differences in elevation ranging from 3 to 10 feet.

This association occupies about 35 percent of the county. About 50 percent is made up of Conover soils, 25 percent of Brookston soils, and 25 percent of minor soils.

Conover soils are nearly level to gently sloping and are somewhat poorly drained. Their surface layer is very dark gray loam about 9 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is light brownish-gray and pale-brown clay loam. Light brownish-gray loam begins at a depth of about 36 inches.

Brookston soils are in depressional areas. They are nearly level and are poorly drained. Their surface layer is very dark brown loam about 13 inches thick. The subsoil is light brownish-gray and grayish-brown clay loam. Light brownish-gray heavy loam begins at a depth of about 42 inches.

The minor soils of this association are those of the Metamora, Macomb, and Celina series. Areas of Metamora and Macomb soils, which are nearly level or gently sloping, are closely intermingled with areas of Conover soils. Celina soils are gently undulating and occupy areas adjacent to drainageways and ridges and knolls.

This association is well suited to corn, beans, small grains, and forage crops. Fertility and available water capacity are high. The main concern of management is removal of excess water. Most of the acreage is used for cash crops. Some areas are in woodland, and some are idle.

This association has moderate to severe limitations for nonfarm uses.

3. *Miami-Conover-Brookston association*

Well-drained to poorly drained, nearly level to steep, loamy soils on till plains and moraines

This association consists of slightly undulating areas and swells and small valleys on till plains that have differences in elevation ranging from 3 to 10 feet and undulating to hilly areas and rounded swells and concave valleys on moraines that have differences in elevation ranging from 10 to 70 feet. Most of the soils are gently sloping to rolling (fig. 2). Steeper soils are common on

Figure 2.—**Typical landscape of rolling Miami soils in soil association 3. Erosion is a hazard if these soils are used for crops.**

rims around potholes and on short side slopes along drainageways.

This association occupies about 24 percent of the county. About 25 percent is made up of Miami soils, 25 percent of Conover soils, 15 percent of Brookston soils, and 35 percent of minor soils.

Miami soils are on rounded swells and side slopes. They are gently sloping to steep and are well drained. Their surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is brown loam about 3 inches thick. The subsoil is brown light clay loam and dark-brown and yellowish-brown clay loam. Brown heavy loam begins at a depth of about 30 inches.

Conover soils are on flat areas, slightly rounded swells, and short side slopes. They are nearly level to gently sloping and are somewhat poorly drained. Their surface layer is very dark gray loam about 9 inches thick. The subsurface layer is brown loam about 4 inches thick. The subsoil is light brownish-gray and pale-brown clay loam. Light brownish-gray loam begins at a depth of about 36 inches.

Brookston soils are in swales, low concave areas, and depressions. They are nearly level and are poorly drained. Their surface layer is very dark brown loam about 13 inches thick. The subsoil is light brownish-gray and grayish-brown clay loam. Light brownish-gray heavy loam begins at a depth of about 42 inches.

The minor soils of this association are those of the Celina, Kendallville, Owosso, and Boyer series. Celina soils, which are gently sloping, are closely intermingled with Conover soils. Kendallville and Owosso soils, which are gently sloping to moderately steep, are closely intermingled or associated with Miami soils. Boyer soils are on lower lying benches and side slopes along major drainageways.

Conover soils, Brookston soils, and the less sloping areas of Miami soils are well suited to corn, beans, small grains, and forage crops. Fertility and available water capacity are high. The main concerns of management are controlling erosion and removal of excess water. Most of the acreage is used for cash crops. There are some dairy farms. A few small areas and the steeper areas of Miami soils are used for woodland, pasture, wildlife habitat, or recreation.

This association has slight to severe limitations for most nonfarm uses, depending on degree of slope or wetness.

4. Boyer-Wasepi-Spinks association

Well-drained and somewhat poorly drained, nearly level to steep, sandy and loamy soils on outwash plains, terraces, and moraines

This association consists mainly of gently undulating plains and swells and small valleys that have differences in elevation ranging from 3 to 10 feet; gently sloping terraces along old glacial drainageways (fig. 3); undulating to hilly swells and valleys that have differences in elevation ranging from 3 to 80 feet; and areas of steep soils along incised drainageways or around deep concave depressions.

This association occupies about 11 percent of the county. About 45 percent is made up of Boyer soils, 20 percent of Wasepi soils, 10 percent of Spinks soils, and 25 percent of minor soils.

Boyer soils are nearly level to steep and are well drained. Their surface layer is dark grayish-brown sandy loam or loamy sand about 8 inches thick. The subsurface layer is brown heavy loamy sand about 4 inches thick. The subsoil is dark yellowish-brown light sandy loam,

Figure 3.—Typical landscape of Boyer and Spinks soils in soil association 4. Spinks soils occupy the gently sloping terraces in the foreground, and Boyer soils occupy the higher areas in the background.

yellowish-brown heavy sandy loam, and dark yellowish-brown gravelly sandy clay loam. Brown, gravelly coarse sand begins at a depth of about 32 inches.

Wasepi soils are on flat areas, slightly rounded swells, and sides of drainageways. They are nearly level to gently sloping and are somewhat poorly drained. Their surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is grayish-brown light sandy loam about 10 inches thick. The subsoil is grayish-brown gravelly light sandy clay loam and brown sandy loam. Light brownish-gray, fine gravelly coarse sand begins at a depth of about 33 inches.

Spinks soils are on flat areas, rounded swells, and sides of drainageways. They are nearly level to moderately steep and are well drained. Their surface layer is dark grayish-brown loamy sand about 8 inches thick. The subsurface layer is yellowish-brown sand about 21 inches thick. The subsoil consists of alternating layers of yellow sand and dark-brown heavy loamy sand. The loamy sand layers are ¼ inch to 3 inches thick. Very pale brown sand begins at a depth of about 44 inches.

The minor soils of this association are those of the Fox, Sebewa, and Gilford series. Fox soils, which are gently sloping to moderately steep, are closely intermingled with Boyer soils on hilly uplands. Sebewa or Gilford soils are wet and occupy swales and low concave areas.

The less sloping soils of this association are moderately suited to corn, small grains, beans, and forage crops if good management practices are followed. Available water capacity is low. Fertility is low in most places. The main concerns of management are conserving moisture and control of soil blowing. Removal of excess water is a concern in managing the Wasepi soils, and erosion is a concern in managing the steeper Boyer and Spinks soils. Most of the acreage of the less sloping soils is used for cash crops. The feeding of beef cattle is also important and there are some dairy farms. The steeper soils are used for woodland or are growing up to brush. Some areas can be used for orchards.

The less sloping areas of Boyer and Spinks soils have few limitations for nonfarm uses. Wasepi soils have severe limitations for many nonfarm uses because of seasonal wetness.

Boyer and Wasepi soils are potential sources of sand and gravel. They also provide good foundation material for houses, streets, and highways, if the soils are not too steep.

5. Kibbie-Colwood-Lenawee association

Somewhat poorly drained and poorly drained, nearly level to gently sloping, loamy soils on lake plains

This association consists of flat to slightly undulating lake plains dissected by streams and drainageways.

This association occupies about 2 percent of the county. About 35 percent is made up of Kibbie soils, 30 percent of Colwood soils, 10 percent of Lenawee soils, and 25 percent of minor soils.

Kibbie soils are nearly level to gently sloping. They are on the slightly higher parts of the landscape and on side slopes of drainageways. They are somewhat poorly drained. Their surface layer is very dark grayish-brown loam about 8 inches thick. The subsurface layer is pale-brown loam about 3 inches thick. The subsoil is grayish-brown heavy fine sandy loam and heavy loam. Light-gray, stratified silt loam and fine sand begin at a depth of about 26 inches.

Colwood soils are nearly level and are poorly drained. Their surface layer is very dark brown loam about 12 inches thick. The subsoil is light brownish-gray heavy loam and gray light sandy clay loam. Light-gray, stratified very fine sand, fine sand, and silt loam begin at a depth of about 38 inches.

Lenawee soils are nearly level and are poorly drained. Their surface layer is very dark gray silt loam about 9 inches thick. The subsoil is gray heavy silt loam and heavy silty clay loam. Gray, stratified silty clay loam and clay loam begin at a depth of about 25 inches.

The minor soils of this association are those of the Berville, Brookston, Tuscola, and Linwood series. Berville and Brookston soils, which are nearly level, are closely intermingled with Colwood soils. Tuscola soils on slightly higher low mounds are closely intermingled with Kibbie soils. Linwood soils are very poorly drained and occupy swales and lower lying concave areas.

This association is well suited to corn, beans, small grains, and forage crops. Fertility and available water capacity are high. The main concern of management is removal of excess water. Maintaining soil tilth is a concern in managing the Lenawee soils. Most of the acreage is used for cash crops. There are some dairy farms. A few small areas are used for woodland, pasture, or wildlife habitat.

Most of this association has moderate to severe limitations for nonfarm uses.

6. Ceresco-Cohoctah-Sloan association

Somewhat poorly drained and poorly drained, nearly level, loamy soils on flood plains

This association consists of flood plains along the Shiawassee River north of the city of Owosso and along the Misteguay Creek and its tributaries. Many swales, old oxbows, and depressions are in these areas. Areas of steep soils along the edge of the flood plain, generally parallel to the river or stream, are also present.

This association occupies about 2 percent of the county. About 15 percent is made up of Ceresco soils, 15 percent of Cohoctah soils, 15 percent of Sloan soils, and 55 percent of minor soils.

Ceresco soils are somewhat poorly drained. They are on slightly higher parts of the landscape. Their surface layer is very dark gray loam about 7 inches thick. The subsoil is dark grayish-brown fine sandy loam and dark-brown sandy loam. Light brownish-gray light sandy loam begins at a depth of about 34 inches.

Cohoctah soils are in swales, old oxbows, and depressions. They are poorly drained. Their surface layer is very dark grayish-brown loam about 8 inches thick. The subsoil is gray and grayish-brown sandy loam. Gray sandy loam begins at a depth of about 28 inches.

Sloan soils are in old oxbows, swales, and depressions. They are poorly drained. Their surface layer is very dark brown loam about 12 inches thick. The subsoil is gray and light brownish-gray loam. Light brownish-gray loam begins at a depth of about 34 inches.

The minor soils of this association are those of the Eel, Landes, Abscota, Brookston, Berville, Conover, and

Miami series. Eel, Landes, and Abscota soils occupy long, narrow, natural levees next to the Shiawassee River. Miami soils occupy steep escarpments parallel to the river and other streams. Brookston, Berville, and Conover soils are nearly level and are on uplands adjacent to the flood plain.

This association is generally poorly suited to cultivated crops (fig. 4). Fertility is medium or high. Available water capacity is moderate or high. The main concerns of management are removal of excess water and control of flooding. Many areas are inaccessible to farm machinery, and other areas are too small to farm. Most of the acreage is used for woodland, pasture, hay crops, or wildlife habitat.

This association has severe limitations for most nonfarm uses because many areas are subject to flooding during some time of the year.

Figure 4.—**Ceresco and Cohoctah soils on flood plains in soil association 6. Because of the flood hazard, these soils are poorly suited to cultivated crops.**

7. *Carlisle-Gilford-Tawas association*

Very poorly drained and poorly drained, nearly level, mucky and loamy soils on outwash plains and in glacial drainageways

This association consists of flat to slightly undulating outwash plains that include old depressional glacial drainageways, which are generally oriented in an east-west direction.

This association occupies about 14 percent of the county. About 30 percent is made up of Carlisle soils, 20 percent of Gilford soils, 15 percent of Tawas soils, and 35 percent of minor soils.

Carlisle soils are nearly level and very poorly drained. Their surface layer is black muck about 8 inches thick. It is underlain by dark reddish-brown muck and mucky peat.

Gilford soils are nearly level and poorly drained. Their surface layer is black sandy loam about 10 inches thick. The subsurface layer is very dark grayish-brown sandy loam about 4 inches thick. The subsoil is light brownish-gray fine sandy loam and grayish-brown sandy loam. Light brownish-gray fine gravelly sand begins at a depth of about 36 inches.

Tawas soils are nearly level and very poorly drained. Their surface layer is black muck about 8 inches thick. It is underlain by black muck and very dark brown mucky peat. Gray sand begins at a depth of about 31 inches.

The minor soils of this association are those of the Boyer, Miami, Sebewa, and Spinks series. Boyer, Miami, and Spinks soils occupy the higher areas near uplands. The Sebewa soils occupy swales and low concave areas.

This association is moderately suited or poorly suited to vegetable crops, corn, and forage crops. Fertility is low in the organic soils and medium in the Gilford soils. Available water capacity is very high in the organic soils. It is low in the Gilford soils. The main concerns of management are removal of excess water and controlling soil blowing.

Most areas of Carlisle soils are used for corn, vegetable crops, and sod production. Many areas of Gilford soils are used for cash crops. Most areas of Tawas soils are wooded. Some areas of this association are used for pasture. The small wooded areas provide wildlife habitat.

This association has very severe limitations for nonfarm uses.

Descriptions of the Soils

In this section the soil series and mapping units of Shiawassee County are described. The approximate acreage and proportionate extent of each mapping unit are given in table 1.

The procedure is first to describe a soil series and then the mapping units in that series. To get full information on any given mapping unit, one needs to read the description of the series as well as the description of the mapping unit.

Each series description includes two descriptions of the same typical profile of a soil of the series. The first is a brief description, in paragraph form, which many readers will find gives as much information as they need. The second is a longer, more detailed description that soil scientists, engineers, and others can use as a basis for technical interpretations.

As explained in the section "How This Survey Was Made," some mapping units are miscellaneous land types rather than soils of any given series. Made land is an example. Such mapping units are described in this section, along with the soil series and the mapping units.

In parentheses following the name of each mapping unit is a symbol made up of capital and small letters and, in some cases, a figure. This symbol identifies the mapping unit on the detailed soil map at the back of this publication. At the end of each soil description are listed the capability unit, the Michigan soil management group in parentheses, the woodland suitability group, and the recreation group in which the mapping unit has been placed. The "Guide to Mapping Units" at the back of this publication, gives the map symbols and names of all the mapping units, in alphabetical order; the number of the page on which each unit is described; the symbol for the capability unit, the woodland suitability group,

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Algansee sandy loam	203	0.1
Barry loam	192	.1
Barry stony loam	148	(1)
Barry sandy loam, bedrock variant	90	(1)
Belding sandy loam, 0 to 2 percent slopes	1,326	.4
Berville loam	12,336	3.6
Boyer loamy sand, 0 to 2 percent slopes	1,713	.5
Boyer loamy sand, 2 to 6 percent slopes	7,180	2.1
Boyer loamy sand, 6 to 12 percent slopes	2,680	.7
Boyer loamy sand, 12 to 18 percent slopes	712	.2
Boyer loamy sand, 18 to 25 percent slopes	415	.1
Boyer very stony loamy sand, 2 to 6 percent slopes	162	(1)
Boyer sandy loam, 0 to 2 percent slopes	931	.3
Boyer sandy loam, 2 to 6 percent slopes	3,890	1.1
Boyer sandy loam, 6 to 12 percent slopes	1,523	.5
Boyer sandy loam, 12 to 18 percent slopes	431	.1
Breckenridge sandy loam	1,498	.4
Brevort loamy sand	272	.1
Brookston loam	62,318	18.0
Carlisle muck	14,040	4.1
Celina loam, 2 to 6 percent slopes	9,055	2.6
Celina loam, 2 to 6 percent slopes, moderately eroded	1,399	.4
Ceresco loam	1,079	.3
Cohoctah loam	1,118	.3
Colwood loam	2,718	.8
Conover loam, 0 to 2 percent slopes	56,222	16.4
Conover loam, 2 to 6 percent slopes	33,817	9.8
Edwards muck	683	.2
Eel, Landes, and Abscota soils	315	.1
Fox sandy loam, 2 to 6 percent slopes	1,150	.3
Fox sandy loam, 6 to 12 percent slopes	738	.2
Fox sandy loam, 12 to 18 percent slopes	263	.1
Gilford sandy loam	8,592	2.5
Gilford stony sandy loam	73	(1)
Gladwin loamy sand, 0 to 2 percent slopes	989	.3
Glendora sandy loam	357	.1
Granby loamy sand	932	.3
Gravel pits	853	.2
Iosco loamy sand, 0 to 2 percent slopes	1,899	.7
Iosco stony loamy sand, 0 to 2 percent slopes	48	(1)
Iosco loamy sand, deep variant	1,106	.3
Kendallville sandy loam, 2 to 6 percent slopes	3,384	1.0
Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded	422	.1
Kendallville sandy loam, 6 to 12 percent slopes	817	.2
Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded	681	.2
Kibbie loam, 0 to 2 percent slopes	2,496	.7
Kibbie loam, 2 to 6 percent slopes	855	.2
Lapeer sandy loam, 2 to 6 percent slopes	316	.1
Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	200	.1
Lenawee silt loam	719	.2
Linwood muck	4,035	1.2
Locke sandy loam, 0 to 2 percent slopes	153	(1)
Locke sandy loam, 2 to 6 percent slopes	140	(1)
Macomb loam, 0 to 2 percent slopes	7,420	2.1
Macomb sandy loam, 2 to 6 percent slopes	4,831	1.4
Made land	741	.2
Mancelona loamy sand, 0 to 2 percent slopes	124	(1)
Mancelona loamy sand, 2 to 6 percent slopes	568	.2
Matherton sandy loam, 0 to 2 percent slopes	3,391	1.0
Matherton sandy loam, 2 to 6 percent slopes	1,147	.3
Matherton sandy loam, loamy substratum, 0 to 2 percent slopes	730	.2
Matherton sandy loam, loamy substratum, 2 to 6 percent slopes	187	.1
Menominee loamy sand, 2 to 6 percent slopes	332	.1
Menominee loamy sand, 6 to 12 percent slopes	124	(1)
Metamora loamy sand, 0 to 2 percent slopes	811	.2
Metamora sandy loam, 0 to 2 percent slopes	3,056	.9
Metamora sandy loam, 2 to 6 percent slopes	4,596	1.3
Miami loam, 2 to 6 percent slopes	1,629	.5
Miami loam, 2 to 6 percent slopes, moderately eroded	3,820	1.1
Miami loam, 6 to 12 percent slopes	1,154	.3
Miami loam, 6 to 12 percent slopes, moderately eroded	11,565	3.3
Miami loam, 12 to 18 percent slopes, moderately eroded	2,538	.8
Miami loam, 18 to 25 percent slopes, moderately eroded	584	.2
Miami clay loam, 12 to 18 percent slopes, severely eroded	126	(1)
Mine pits	66	(1)
Newaygo sandy loam, 2 to 6 percent slopes	957	.3
Ottokee loamy sand, 0 to 2 percent slopes	1,264	.4
Owosso-Miami sandy loams, 2 to 6 percent slopes	3,167	.9
Owosso-Miami sandy loams, 6 to 12 percent slopes	982	.3
Owosso-Miami sandy loams, 12 to 18 percent slopes, moderately eroded	487	.1
Plainfield loamy sand, slightly acid variant, 2 to 6 percent slopes	250	.1
Plainfield loamy sand, slightly acid variant, 6 to 12 percent slopes	105	(1)
Richter loamy fine sand, 0 to 2 percent slopes	316	.1
Sebewa loam	7,144	2.1
Shoals loam	304	.1
Sloan loam	1,047	.3
Spinks loamy sand, 0 to 2 percent slopes	384	.1
Spinks loamy sand, 2 to 6 percent slopes	2,927	.9
Spinks loamy sand, 6 to 12 percent slopes	1,167	.3
Spinks loamy sand, 12 to 18 percent slopes	311	.1
Tawas muck	6,301	1.8
Tuscola loam, 2 to 6 percent slopes	1,173	.3
Wallkill loam	70	(1)
Wasepi sandy loam, 0 to 2 percent slopes	5,738	1.7
Wasepi sandy loam, 2 to 6 percent slopes	3,141	.9
Miscellaneous, built-up areas, and lakes	9,141	2.7
Total	345,600	100.0

[1] Less than 0.05 percent.

and the recreation group for each mapping unit; and the page where the description of each group can be found.

Technical terms used in describing the soils are defined in the Glossary.

Abscota Series

The Abscota series consists of well-drained, nearly level soils on flood plains of the major streams in the county. These soils formed in sandy, water-laid material. The native vegetation consisted mainly of elm, red maple, black ash, and aspen. In this county, Abscota soils are mapped with Eel and Landes soils in an undifferentiated group.

In a representative profile the surface layer is dark grayish-brown sandy loam about 10 inches thick. The underlying material is dark yellowish-brown and brown loamy sand to a depth of about 40 inches. Below this, it is very pale brown sand.

Permeability is rapid, the available water capacity is

low, and fertility is low. Flooding seldom occurs after May. Surface runoff is slow.

Abscota soils are moderately well suited to woodland, forage crops, and pasture. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe.

Most areas of these soils are used for woodland. Small areas are used for crops or pasture.

Representative profile of Abscota sandy loam from an area of Eel, Landes, and Abscota soils:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; neutral; abrupt; smooth boundary.
C1—10 to 27 inches, dark yellowish-brown (10YR 4/4) loamy sand; weak, fine, subangular blocky structure; very friable; mildly alkaline; clear, wavy boundary.
C2—27 to 40 inches, brown (10YR 5/3) loamy sand; single grain; loose; neutral; clear, wavy boundary.
C3—40 to 60 inches, very pale brown (10YR 7/3) sand; few, fine, distinct, brownish-yellow (10YR 6/8) mottles; single grain; loose; mildly alkaline.

The A horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) and is 2 to 6 inches thick in uncultivated areas and 7 to 10 inches thick in cultivated areas. It is neutral or slightly acid. The C1 horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4 or 5/6) and is mildly alkaline or neutral. The C2 horizon is brown (10YR 5/3) or light yellowish-brown (10YR 6/4) loamy sand or sand and is neutral or mildly alkaline. The C3 horizon has brownish-yellow (10YR 6/6 or 6/8) or yellowish-brown (10YR 5/4, 5/6, or 5/8) mottles. It is mildly alkaline and has slight effervescence below a depth of 36 inches in a few profiles. Strata of gravelly sand less than 4 inches thick are below the A horizon in a few profiles.

Abscota soils formed in the same kind of material as Algansee and Glendora soils. They lack the mottles immediately beneath the Ap horizon that are in the Algansee and Glendora soils. They are similar to Plainfield soils, slightly acid variant, but they have finer texture in the upper part of the profile. They are mapped in an undifferentiated group with Eel and Landes soils, but they are dominantly coarser textured in the subhorizons than these soils.

Algansee Series

The Algansee series consists of somewhat poorly drained, nearly level soils on flood plains of the major streams and rivers. These soils formed in sandy, waterlaid material. The native vegetation consists of soft maple, elm, swamp oak, and aspen.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 10 inches thick. The underlying material, to a depth of about 27 inches, is grayish-brown loamy sand mottled with yellowish brown. Below this is grayish-brown sand mottled with yellowish brown.

Permeability is rapid, available water capacity is low, and fertility is low. Flooding is likely in spring and after prolonged rain. Surface runoff is slow.

Algansee soils are very poorly suited to farming. They are well suited to openland wildlife habitat. Limitations for many nonfarm uses are severe. The soils are generally poorly suited to woodland.

Most areas of these soils are wooded or are in unimproved pasture. A few areas are used for crops.

Representative profile of Algansee sandy loam:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.
C1—10 to 27 inches, grayish-brown (10YR 5/2) loamy sand; few, fine, distinct, yellowish-brown (10YR 5/4) mottles; single grain; loose; neutral; gradual, wavy boundary.
C2—27 to 60 inches, grayish-brown (10YR 5/2) sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; mildly alkaline.

The solum is neutral or slightly acid. The A horizon is very dark grayish brown (10YR 3/2) or very dark gray (10YR 4/1) and is 8 to 10 inches thick. Thin layers of fine gravelly sand or fine gravelly loamy sand are in the C1 horizon of a few profiles. The C2 horizon is gravelly sand in a few profiles. In a few profiles the C horizon has slight effervescence at a depth below 45 inches.

The matrix colors in the subhorizons of these soils are more grayish than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Algansee soils formed in the same kind of material as Abscota and Glendora soils. They have mottles immediately beneath the Ap horizon that are lacking in Abscota soils, and they are dominantly less gray in the subhorizons than Glendora soils. Algansee soils are similar to Shoals soils in drainage but are coarser textured throughout the profile than those soils.

Algansee sandy loam (0 to 2 percent slopes) (Ah).—This soil is on flood plains of the major streams. The areas are small to medium in size and are irregular in shape.

Included in mapping are a few small areas that have a loam surface layer. Also included are a few small areas of poorly drained Glendora soils at slightly lower elevations.

This soil is flooded in spring and occasionally during the growing season. Permeability is rapid, the available water capacity is low, and fertility is low. Removing excess water and controlling flooding are the main concerns of management, but improving fertility, conserving moisture, and preventing frost damage are also important.

Most areas of this soil are used for woodland or pasture. A few areas are used for crops. This soil is very poorly suited to farming, but it is suited to pasture. It has severe limitations for most recreational and urban developments. Capability unit VIIw-1 (L-4c); woodland suitability group O; recreation group 6.

Barry Series

The Barry series consists of poorly drained, nearly level soils in depressional areas on till plains. These soils formed in sandy loam glacial till. The native vegetation consists of elm, ash, and aspen.

In a representative profile the surface layer is very dark gray loam about 10 inches thick. The upper 6 inches of the subsoil is gray, friable loam mottled with yellowish brown. The next 9 inches is grayish-brown, firm heavy loam mottled with yellowish brown. The lower 11 inches is gray, firm sandy clay loam mottled with yellowish-brown. The underlying material, beginning at a depth of about 36 inches, is brown sandy loam mottled with gray.

Permeability is moderate, the available water capacity is moderate, and fertility is medium. Surface runoff is very slow or ponded.

Barry soils are moderately well suited to farming if the excess water is removed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. The soils are generally poorly suited to woodland.

Most areas of these soils are small and remain in woodland, or are cultivated along with larger areas of other soils.

Representative profile of Barry loam:

Ap—0 to 10 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable; less than 5 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B21tg—10 to 16 inches, gray (10YR 5/1) loam; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; very dark brown (10YR 2/2) clay-organic films on surfaces of peds; less than 5 percent coarse fragments; mildly alkaline; gradual, wavy boundary.

B22tg—16 to 25 inches, grayish-brown (10YR 5/2) heavy loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; less than 5 percent coarse fragments; mildly alkaline; gradual, wavy boundary.

B23tg—25 to 36 inches, gray (10YR 5/1) sandy clay loam; few, fine, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 15 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

C—36 to 60 inches, brown (10YR 5/3) sandy loam; few, fine, faint, gray (10YR 5/1) mottles; massive; friable; 15 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is slightly acid to mildly alkaline throughout. The Ap horizon is very dark brown (10YR 2/2) or very dark gray (10YR 3/1) and ranges from 10 to 13 inches in thickness. The B horizon is dark grayish brown (10YR 4/2), light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or gray (10YR 5/1). The B21g horizon is loam or sandy loam. The B22tg and B23tg horizons are heavy sandy loam, sandy clay loam, or loam. The C horizon is gray (10YR 5/1), grayish brown (10YR 5/2), or brown (10YR 5/3). It is loamy sand in a few profiles. The C horizon is mildly alkaline or moderately alkaline and has slight effervescence.

Barry soils formed in the same kind of material as Lapeer and Locke soils. They have mottles in the B horizon, which are lacking in Lapeer soils, and have a darker colored A horizon than those soils. They have a thicker, dark-colored A horizon than Locke soils. They have drainage similar to that of the bedrock variant of Barry soils, and to Berville, Brookston, and Gilford soils. Barry soils differ from Barry soils, bedrock variant, in lacking bedrock at a depth of less than 40 inches. They lack the gravelly texture that is in all or part of the Bt horizon of Berville soils. Barry soils have more sand separates throughout the profile than Brookston soils. They lack the gravelly sand material that is in the C horizon of Gilford soils.

Barry loam (0 to 2 percent slopes) (Ba).—This soil is in depressions and drainageways. The areas are small in size and irregular in shape. This soil has the profile described as representative of the series. Included in mapping are a few small areas of poorly drained Sebewa soil.

Surface runoff is very slow or ponded. Removal of excess water is the major concern of management.

Most areas of this soil are small and remain in woodland or are cultivated along with large areas of other soils. This soil is well suited to farming if excess water is removed. It has severe limitations for recreational and urban developments. Capability unit IIw-6 (3c); woodland suitability group W; recreation group 4.

Barry stony loam (0 to 2 percent slopes) (Bc).—This soil is in depressions. The areas are small in size and irregular in shape. Stones, 10 to 20 inches in diameter and 30 to 100 feet apart, are on the surface or in the surface layer. Many cobblestones, 3 to 6 inches in diameter, are beneath the surface layer, at a depth of 10 to 12 inches. Included in mapping are a few small areas of the somewhat poorly drained Locke soil.

Surface runoff is very slow or ponded. Removal of stones and excess water are the major concerns of management.

Most areas of this soil are small and are used for pasture or hay. This soil is well suited to farming if excess water and stones are removed. It has severe limitations for recreational and urban developments. Capability unit IIw-6 (3c); woodland suitability group W; recreation group 4.

Barry Series, Bedrock Variant

The Barry series, bedrock variant, consists of poorly drained, nearly level soils on till plains. These soils formed in sandy loam glacial till and are underlain by sandstone bedrock at a depth of 24 to 40 inches. The native vegetation consisted of elm, ash, and aspen.

In a representative profile the surface layer is very dark gray sandy loam in the upper 8 inches and very dark grayish-brown sandy loam in the lower 3 inches. The subsoil, about 27 inches thick, is gray, friable sandy loam mottled with strong brown. The underlying material, beginning at a depth of about 38 inches, is sandstone bedrock.

Permeability is moderately rapid above the bedrock. The available water capacity is low, and fertility is medium. Surface runoff is very slow or ponded.

Barry soils, bedrock variant, are moderately suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are idle or are in woodland. A few small areas are used for crops or pasture.

Representative profile of Barry sandy loam, bedrock variant:

Ap—0 to 8 inches, very dark gray (10YR 3/1) sandy loam; moderate, fine, granular structure; friable; less than 5 percent coarse fragments; medium acid; abrupt, smooth boundary.

A12—8 to 11 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, coarse, granular structure; friable; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

Bg—11 to 38 inches, gray (10YR 6/1) sandy loam; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; weak, medium, subangular blocky structure; friable; very dark brown (10YR 2/2) clay-organic films on surfaces of peds in upper part; 5 percent coarse fragments in upper 23 inches; 15 percent sandstone fragments in the lower 4 inches; slightly acid; gradual, wavy boundary.

IIR—38 inches +, sandstone bedrock.

The solum ranges from 30 to 40 inches in thickness and is medium acid or slightly acid throughout. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), very dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2) and is 10 to 13 inches thick. The B horizon is sandy loam, fine sandy loam, or sandy clay loam.

Barry soils, bedrock variant, have drainage similar to that of the Barry, Berville, and Brookston soils. They formed in the same kind of material as Locke soils. They differ from all these soils in having bedrock at a depth of less than 40 inches.

Barry sandy loam, bedrock variant (0 to 2 percent slopes) (Bb).—This soil is on broad flats and swales border-

ing natural drainageways. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of somewhat poorly drained soils and a few areas where the depth to bedrock is as much as 48 inches. Also included are some areas where cobblestones are in the surface layer.

Surface runoff is very slow or ponded. The main concern of management is removal of excess water.

Most areas of this soil are in woodland or are idle. A few areas are cultivated. In many areas the shallowness to bedrock interferes with the installation of artificial drainage. This soil is moderately well suited to farming if excess water is removed. It has severe to very severe limitations for recreational and urban developments. Capability unit IIw-6 (3/Rc); woodland suitability group W; recreation group 4.

Belding Series

The Belding series consists of somewhat poorly drained, nearly level soils on till plains. These soils formed in sandy loam material, 18 to 42 inches thick, and the underlying loam glacial till. The native vegetation consisted mainly of elm, ash, hickory, and basswood.

In a representative profile the surface layer is very dark gray sandy loam about 9 inches thick. The upper 9 inches of the subsoil is dark-brown, very friable light sandy loam mottled with brownish yellow. The next 8 inches is pale-brown, very friable heavy loam sand mottled with brownish yellow. The lower 10 inches is pale-brown, firm light clay loam mottled with dark yellowish brown. The underlying material, beginning at a depth of about 36 inches, is light brownish-gray heavy loam mottled with yellowish brown.

Permeability is moderately rapid in the upper part of the subsoil and moderately slow in the lower part and in the underlying material. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

Belding soils are well suited to farming if excess water is removed. They are well suited to openland wildlife habitat and are moderately well suited to wetland wildlife habitat. Limitations for nonfarm uses are moderate to severe. Belding soils are moderately to poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for pasture or are wooded.

Representative profile of Belding sandy loam:

Ap—0 to 9 inches, very dark gray (10YR 3/1) sandy loam; weak, fine, granular structure; friable; less than 1 percent coarse fragments; slightly acid; abrupt, smooth boundary.

Bir—9 to 18 inches, dark-brown (7.5YR 4/4) light sandy loam; few, fine, distinct, brownish-yellow (10YR 6/8) mottles; very weak, coarse, granular structure; very friable; less than 1 percent coarse fragments; slightly acid; abrupt, wavy boundary.

A'2—18 to 26 inches, pale-brown (10YR 6/3) heavy loamy sand; many, fine, distinct, brownish-yellow (10YR 6/8) mottles; very weak, medium, subangular blocky structure; very friable; less than 1 percent coarse fragments; medium acid; clear, irregular boundary.

IIB't—26 to 36 inches, pale-brown (10YR 6/3) light clay loam; many, fine, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

IIC—36 to 60 inches, light brownish-gray (2.5Y 6/2) heavy loam; many, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 18 to 42 inches in thickness and is medium acid to mildly alkaline throughout. The A1 horizon, where present, is very dark gray (10YR 3/1) or very dark brown (10YR 2/2) and is 2 to 4 inches thick. The A'2 horizon, where present, is gray (10YR 5/1) or grayish brown (10YR 5/2) and is 1 to 3 inches thick. The IIB't horizon is sandy clay loam, light clay loam, or heavy loam. The IIC horizon is mildly alkaline or moderately alkaline and has slight effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Belding soils formed in the same kind of material as Breckenridge soils. They are less yellowish or grayish in the B horizon than Breckenridge soils. Belding soils are similar to Richter soils, but they lack the stratified soil material that is in the C horizon of Richter soils. Belding soils in most areas are near Conover and Iosco soils. They have a coarser texture in the upper part of the profile than Conover soils. They dominantly have a finer texture in the upper part of the solum than Iosco soils.

Belding sandy loam, 0 to 2 percent slopes (BeA).—This soil is on broad flats near beach ridges. The areas are small to medium in size and are irregular in shape.

Included with this soil in mapping are small areas that have a loam surface layer or are gently sloping. Also included in depressions and drainageways are small areas of Breckenridge soils, which are poorly drained.

Surface runoff is slow. Removal of excess water is the major concern of management.

Most areas of this soil are used for crops. A few areas are used for pasture or are wooded. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2b); woodland suitability group G; recreation group 3.

Berville Series

The Berville series consists of poorly drained, nearly level soils in depressions and drainageways on till plains and moraines. These soils formed in loamy and gravelly loamy material. The native vegetation consisted mainly of elm, ash, maple, and swamp white oak.

In a representative profile the surface layer is very dark brown loam about 10 inches thick. The upper 5 inches of the subsoil is light brownish-gray, friable loam mottled with yellowish brown. The next 13 inches is light brownish-gray, firm gravelly sandy clay loam mottled with brownish yellow. The lower 9 inches is grayish-brown, firm gravelly light clay loam mottled with yellowish brown. The underlying material, beginning at a depth of about 37 inches, is brown light clay loam mottled with light gray.

Permeability is moderately slow, the available water capacity is high, and fertility is high. Surface runoff is very slow or ponded.

Berville soils are well suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for crops. Corn and forage are the main crops. A few areas are used for pasture or are wooded.

Representative profile of Berville loam:

Ap—0 to 10 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable; less than 5 percent coarse fragments; slightly acid; abrupt, smooth boundary.

B21tg—10 to 15 inches, light brownish-gray (10YR 6/2) loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; very dark brown (10YR 2/2) clay-organic films on surfaces of peds; less than 5 percent coarse fragments; neutral; gradual, wavy boundary.

B22tg—15 to 28 inches, light brownish-gray (10YR 6/2) gravelly sandy clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 25 percent coarse fragments; mildly alkaline; gradual, wavy boundary.

B23tg—28 to 37 inches, grayish-brown (10YR 5/2) gravelly light clay loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 25 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

IIC—37 to 60 inches, brown (10YR 5/3) light clay loam; many, medium, distinct, light-gray (10YR 7/1) mottles; very weak, coarse, subangular blocky structure; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 18 to 42 inches in thickness and is slightly acid to moderately alkaline throughout. The A horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) and is 10 to 13 inches thick. The B horizon is gray (10YR 5/1), light brownish gray (10YR 6/2), grayish brown (10YR 5/2), or dark gray (10YR 4/1). It is loam, sandy clay loam, or light clay loam, or gravelly analogs of these textures. The IIC horizon is gray (10YR 5/1), brown (10YR 5/3), or grayish brown (10YR 5/2) and is light clay loam or loam. It is mildly alkaline or moderately alkaline and has slight to strong effervescence.

Berville soils formed in the same kind of material as Kendallville and Macomb soils. They have mottles in the B horizon that are lacking in Kendallville soils. They have a thicker, darker colored Ap or A1 horizon than Macomb soils. Berville soils have drainage similar to that of the Barry soils, bedrock variant, and to Barry and Brookston soils. They are deeper to bedrock than Barry soils, bedrock variant. They have gravelly layers in the Bt horizon, which are lacking in Barry and Brookston soils.

Berville loam (0 to 2 percent slopes) (Bh).—This soil is in depressions, swales, and drainageways. The areas are small to large in size and irregular in shape.

Included with this soil in mapping are small areas of somewhat poorly drained Macomb soils, in higher lying areas, and areas of Richter soils, mainly along drainageways. Also included are a few areas of poorly drained Sebewa soils.

Surface runoff is very slow or ponded. Permeability is moderately slow. The major concern of management is removal of excess water.

Most areas of this soil are used for crops. This soil is well suited to farming if excess water is removed. It has severe limitations for recreational and urban developments. Capability unit IIw-4 (3/2c); woodland suitability group P; recreation group 4.

Boyer Series

The Boyer series consists of well-drained, nearly level to gently sloping soils on outwash plains and gently sloping to steep soils on moraines. These soils formed in sandy loam or loamy sand material, 24 to 42 inches thick, over gravelly sand. The native vegetation consisted mainly of oak, hickory, and maple.

In a representative profile the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is brown heavy loamy sand about 4 inches thick. The upper 5 inches of the subsoil is dark yellowish-brown, very friable light sandy loam. The middle 9 inches is yellowish-brown, friable heavy sandy loam. The lower 6 inches is dark yellowish-brown, firm gravelly sandy clay loam. The underlying material, beginning at a depth of about 32 inches, is brown gravelly coarse sand.

Permeability is moderately rapid, and the available water capacity is low. Fertility is low for the loamy sand phases and medium for the sandy loam phases.

The less sloping Boyer soils are moderately well suited to farming. They are well suited to openland and woodland wildlife habitat. Limitations for nonfarm uses are few on less sloping soils. These soils are well suited to pines and moderately well suited to hardwoods.

Most areas of the nearly level to sloping soils are used for crops. Many areas of the steeper soils have been farmed in the past but are now idle or are in brush and trees. The steepest soils remain in woodland.

Representative profile of a Boyer sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, medium, granular structure; friable; less than 5 percent gravel; slightly acid; abrupt, smooth boundary.

A2—8 to 12 inches, brown (10YR 5/3) heavy loamy sand; weak, coarse, granular structure; very friable; less than 5 percent gravel; slightly acid; clear, wavy boundary.

B1—12 to 17 inches, dark yellowish-brown (10YR 4/4) light sandy loam; weak, fine, subangular blocky structure; very friable; 5 percent gravel; medium acid; clear, wavy boundary.

B21t—17 to 26 inches, yellowish-brown (10YR 5/6) heavy sandy loam; weak, medium, subangular blocky structure; friable; clay films on surfaces of peds; 15 percent fine gravel; slightly acid; gradual, wavy boundary.

B22t—26 to 32 inches, dark yellowish-brown (10YR 4/4) gravelly sandy clay loam; weak, coarse, subangular blocky structure; firm; clay films on surfaces of peds; 25 percent gravel; neutral; abrupt, irregular boundary.

IIC—32 to 60 inches, brown (10YR 5/3) gravelly coarse sand; single grain; loose; 30 percent gravel; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness. It is medium acid to slightly acid above the B22t horizon. The B22t horizon ranges from slightly acid to mildly alkaline. The Ap horizon is dark grayish brown (10YR 4/2) or brown (10YR 5/3) and is 7 to 10 inches thick. The B1 and B21t horizons are loamy sand or sandy loam. The IIC horizon is sand or coarse sand or is gravelly or very gravelly analogs of these textures. It is mildly alkaline or moderately alkaline and has slight or strong effervescence.

Boyer soils formed in the same kind of material as Gilford and Wasepi soils. They lack the mottles in the solum that are typical of Gilford and Wasepi soils, and they have a thinner or lighter colored A horizon than those soils. Boyer soils have drainage similar to that of the Fox, Lapeer, and Spinks soils. They have a lower content of clay in the Bt horizon than Fox soils. They have a coarser texture and average more coarse fragments in the C horizon than Lapeer soils. They have a finer texture in the solum than Spinks soils in horizons of similar horizon designation.

Boyer loamy sand, 0 to 2 percent slopes (BmA).—This soil is adjacent to more sloping Boyer soils. The areas are medium to large in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that it has a coarser texture. Included with this soil in mapping are the poorly drained Gilford soils in small depressions.

Surface runoff is slow. The hazard of soil blowing is severe if the surface is exposed. The available water capacity is low, and fertility is low. The main concerns of management are control of soil blowing, conserving moisture, and improving and maintaining fertility and organic-matter content.

Most areas of this soil are used for crops. A few areas are in second-growth woodland. This soil is moderately suited to farming. It has slight limitations for most recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group C; recreation group 1.

Boyer loamy sand, 2 to 6 percent slopes (BmB).—This soil is on knolls and ridges. The areas are small to large in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that it has a coarser texture. Slopes are less than 100 feet long.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi and poorly drained Gilford soils. Also included are a few small eroded areas where the slope is 4 to 6 percent. These eroded areas have lost as much as 6 inches of the original surface layer and are browner than the uneroded soils.

Surface runoff is slow. The hazard of soil blowing is severe if the surface is exposed. The available water capacity is low, and fertility is low. The main concerns of management are conserving moisture, control of soil blowing, and improving and maintaining organic-matter content.

Most areas of this soil are used for crops. This soil is moderately suited to farming. It has slight limitations for most recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group C; recreation group 1.

Boyer loamy sand, 6 to 12 percent slopes (BmC).—This soil is on moraines. The areas are small to medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that it has a coarser texture. Slopes are less than 100 feet long. Cobblestones and gravel are on the surface in some areas but do not interfere with tillage.

Included with this soil in mapping are a few small areas of the poorly drained Gilford soils in depressions and narrow drainageways. Also included are small eroded areas that have lost as much as 8 inches of the original surface layer through erosion. The soils in these eroded areas are less productive, have less organic matter, and are browner than the uneroded soils.

Surface runoff is slow to medium, and the hazard of erosion is moderate to severe. The available water capacity is low, and fertility is low. The main concerns of management are controlling erosion, conserving soil moisture, and improving and maintaining fertility and organic-matter content.

Most areas of this soil are used for row crops. A few areas are used for hay. Other areas are used for permanent pasture or are in second-growth woodland. This soil is moderately suited to small grain and forage crops. It has moderate limitations for most recreational and urban developments. Capability unit IIIe-9 (4a); woodland suitability group C; recreation group 1.

Boyer loamy sand, 12 to 18 percent slopes (BmD).—This soil is on moraines. The areas are small to medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that it has a coarser texture. Because these soils are steeper and runoff is greater, this soil is more droughty than less sloping soils of this series. Because about 6 inches of the original surface layer has been lost through erosion, the present surface layer is browner.

Included with this soil in mapping are small severely eroded areas on side slopes and small areas of the poorly drained Gilford soils in small depressions and narrow drainageways.

Surface runoff is medium to rapid, and the hazard of erosion is severe. The available water capacity is low, and fertility is low. The main concerns of management are controlling erosion and conserving moisture. Implementing conservation practices is difficult because of the many short complex slopes.

Most areas of this soil have been farmed, but they are now used for pasture or hay. This soil is poorly suited to row crops and moderately suited to small grains and forage crops. It has severe limitations for most recreational and urban developments. Capability unit IVe-9 (4a); woodland suitability group C; recreation group 1.

Boyer loamy sand, 18 to 25 percent slopes (BmE).—This soil is near drainageways or long narrow breaks along flood plains. The areas are small in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that it has coarser texture.

Included with this soil in mapping are a few small areas of Fox soils. Also included are a few small areas where slopes are 25 to 40 percent or where small, severely eroded areas occur on the side slopes.

Surface runoff is rapid, and the hazard of erosion is severe. The available water capacity is low, and fertility is low. The main concerns of management are controlling erosion and conserving moisture.

Most areas of this soil are not cultivated. This soil is not suited to row crops and small grains because it is steep and the hazard of erosion is severe. This soil is moderately well suited to pasture and forage crops. Overgrazing of pasture results in gullies and sheet erosion in places. This soil has severe limitations for recreational and urban developments. Capability unit VIe-2 (4a); woodland suitability group C; recreation group 1.

Boyer very stony loamy sand, 2 to 6 percent slopes (BoB).—This soil is on knolls, ridges, and low mounds. The areas are small in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer and subsurface layer have a coarser texture. Stones, 10 to 20 inches in diameter and 5 to 30 feet apart, are on the surface or in the surface layer. Many cobblestones, 3 to 6 inches in diameter, are below the surface layer, at a depth of 10 to 12 inches. Included with this soil in mapping are a few small areas of Gilford stony sandy loam in depressions.

Surface runoff is slow. The available water capacity is low, and fertility is low. The main concerns of management are controlling erosion, removing stones, and conserving moisture.

Most areas of this soil are used for pasture. A few areas remain wooded. Sufficient stones are present to make tillage of intertilled crops impractical. This soil is poorly suited to row crops. It has moderate to severe limitations for recreational and urban developments. Capability unit VIe-2 (4a); woodland suitability group C; recreation group 1.

Boyer sandy loam, 0 to 2 percent slopes (BrA).—This soil is on outwash plains. The areas are small to large in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the poorly drained Gilford soils in drainageways and depressions. Some of these included areas are covered by 4 to 6 inches of sandy overwash material.

Surface runoff is slow, and the hazard of soil blowing is moderate if large areas of the surface are exposed. The available water capacity is low, and fertility is medium. The main concern of management is conserving moisture.

Most areas of this soil are cultivated. A few areas are in second-growth woodland. This soil is moderately suited to farming. It has slight limitations for recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group C; recreation group 1.

Boyer sandy loam, 2 to 6 percent slopes (BrB).—This soil is on knolls and ridges. The areas are small to large in size and irregular in shape. Slopes are less than 100 feet long.

Included with this soil in mapping are a few small areas of the poorly drained Gilford soils or the somewhat poorly drained Wasepi soils. Also included are a few eroded areas where the slope is 4 to 6 percent. These areas have lost as much as 6 inches of the original surface layer and are browner than the uneroded soils.

Surface runoff is slow to medium, and the hazard of soil blowing is moderate if large areas of the surface are exposed. The available water capacity is low, and fertility is medium. The main concern of management is conserving moisture.

Most areas of this soil are cultivated. A few areas are wooded. This soil is moderately suited to farming. It has slight limitations for recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group C; recreation group 1.

Boyer sandy loam, 6 to 12 percent slopes (BrC).—This soil is on moraines and along drainageways and long, narrow breaks near flood plains. The areas are small in size and irregular in shape. Cobblestones and gravel are on the surface in some areas but not in sufficient quantity to interfere with tillage.

Included with this soil in mapping are a few small areas of the poorly drained Gilford soils in depressions. Also included are some small eroded areas that have less organic matter and a browner surface layer.

Surface runoff is medium, and the hazard of erosion is moderate to severe. The available water capacity is low, and fertility is medium. The main concerns of management are controlling water erosion and conserving moisture.

Most areas of this soil are used for crops, pasture, or hay. This soil is moderately to poorly suited to row crops. It has moderate limitations for most recreational and urban developments. Capability unit IIIe-9 (4a); woodland group C; recreation group 1.

Boyer sandy loam, 12 to 18 percent slopes (BrD).—This hilly soil is on moraines. The areas are small in size and irregular in shape. This soil has lost as much as 6 inches of the original surface layer through erosion. This soil has a profile similar to the one described as representative of the series, except that the present surface layer is browner.

Included with this soil in mapping are small, severely eroded areas on side slopes. In these areas the subsoil is exposed. Also included are small areas of the poorly drained Gilford soils in depressions and narrow drainageways.

Surface runoff is rapid, and the hazard of erosion is severe. The available water capacity is low, and fertility is medium. The main concerns of management are controlling erosion and conserving moisture. Implementing conservation practices is difficult.

Most areas of this soil have been farmed, but they are now in pasture or hay. A few areas are wooded. This soil is poorly suited to row crops and is moderately suited to small grains and forage crops. This soil has severe limitations for most recreational and urban developments. Capability unit IVe-9 (4a); woodland suitability group C; recreation group 1.

Breckenridge Series

The Breckenridge series consists of poorly drained, nearly level soils on till plains. These soils formed in sandy loam material, 18 to 42 inches thick, and in the underlying clay loam glacial till. The native vegetation consisted mainly of elm, ash, and red maple.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 10 inches thick. The subsurface layer is light brownish-gray loamy sand about 10 inches thick. The upper 6 inches of the subsoil is yellowish-brown, friable sandy loam mottled with light brownish gray; the lower 4 inches is grayish-brown, friable sandy clay loam mottled with olive yellow. The underlying material, beginning at a depth of about 30 inches, is light brownish-gray clay loam mottled with olive brown.

Permeability is moderately rapid in the subsoil and moderately slow in the underlying material. The available water capacity is moderate, and fertility is high. Surface runoff is very slow or ponded.

Breckenridge soils are well suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are wooded.

Representative profile of Breckenridge sandy loam:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; less than 5 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

A2g—10 to 20 inches, light brownish-gray (2.5Y 6/2) loamy sand; few, fine, faint, light olive-brown (2.5Y 5/6) mottles; weak, fine, subangular blocky structure;

friable; less than 5 percent coarse fragments; mildly alkaline, clear, wavy boundary.

B21—20 to 26 inches, yellowish-brown (10YR 5/6) sandy loam; common, medium, distinct, light brownish-gray (2.5Y 6/2) mottles; weak, medium, subangular blocky structure; friable; less than 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

B22tg—26 to 30 inches, grayish-brown (2.5Y 5/2) sandy clay loam; common, fine, distinct, olive-yellow (2.5Y 6/8) mottles; moderate, medium, subangular blocky structure; friable; less than 5 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

IICg—30 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam; common, fine, distinct, olive-brown (2.5Y 4/4) mottles; massive; firm; 10 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness, but it is dominantly 25 to 35 inches thick. It is neutral or mildly alkaline throughout. The Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or black (10YR 2/1) and is 9 to 12 inches thick. The A2g horizon is loamy sand or sandy loam. The B21 horizon is grayish brown (10YR 5/2), yellowish brown (10YR 5/6), or gray (10YR 5/1) and is sandy loam or fine sandy loam. The B22tg horizon is gray (10YR 5/1), light brownish gray (10YR 6/2), or grayish brown (2.5Y 5/2) and is light clay loam or sandy clay loam. The IIC horizon is gray (10YR or 2.5Y 5/1), grayish brown (10YR or 2.5Y 5/2), or light brownish gray (10YR or 2.5Y 6/2) and is loam or clay loam. The IIC horizon is mildly alkaline or moderately alkaline and has slight effervescence.

The average annual temperature of these soils is a few degrees warmer, the matrix colors of some subhorizons are brighter and the dark-colored surface layer is thicker than is defined as the range for the series, but these differences do not alter the usefulness and behavior of these soils.

Breckenridge soils formed in the same kind of material as Belding soils. They are not so brown in the B horizon as Belding soils. Breckenridge soils have drainage similar to that of Brevort and Colwood soils. They dominantly have a finer texture in the solum than Brevort soils. They lack the stratified material in the C horizon that is in the Colwood soils.

Breckenridge sandy loam (0 to 2 percent slopes) (Bt).—This soil is in depressions and drainageways. The areas are small to large in size and irregular in shape.

Included with this soil in mapping are small areas in depressions that are covered by a thin layer of loamy overwash. Also included are small areas of the somewhat poorly drained Belding soils at slightly higher elevations, and a few areas in small depressions that have a surface layer of muck.

Many areas of these soils are commonly ponded early in spring and after heavy rains. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. Some areas remain in woodland. This soil is well suited to farming if excess water is removed. It has severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2c); woodland suitability group W; recreation group 4.

Brevort Series

The Brevort series consists of nearly level, poorly drained soils in depressions on till plains, lake plains, and outwash plains. These soils formed in sandy materials, 18 to 42 inches thick, over loamy glacial till. The native vegetation consisted mainly of aspen, soft maple, and elm.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 8 inches thick. The upper 10 inches of the subsoil is gray, very friable loamy sand mottled with dark brown; the lower 10 inches is light brownish-gray, loose sand mottled with yellowish brown. The underlying material, beginning at a depth of about 28 inches, is light brownish-gray clay loam mottled with yellowish brown.

Permeability is moderately rapid in the sandy material in the upper 18 to 42 inches and moderately slow in the loamy underlying material. The available water capacity is moderate, and fertility is low. Surface runoff is very slow or ponded.

Brevort soils are moderately suited to farming if excess water is removed and fertility is maintained. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops or pasture. Some areas are wooded.

Representative profile of Brevort loamy sand:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; less than 1 percent coarse fragments; mildly alkaline; abrupt, smooth boundary.

B21g—8 to 18 inches, gray (10YR 5/1) loamy sand; few, medium, distinct, dark-brown (10YR 4/3) mottles; very weak, coarse, granular structure; very friable; less than 1 percent coarse fragments; neutral; gradual, wavy boundary.

B22—18 to 28 inches, light brownish-gray (10YR 6/2) sand; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; less than 1 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

IIC—28 to 60 inches, light brownish-gray (10YR 6/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness, but it is dominantly 24 to 37 inches thick. It is neutral or mildly alkaline throughout. The Ap horizon is black (10YR 2/1), very dark grayish brown (10YR 3/2), or very dark brown (10YR 2/2) and is 5 to 10 inches thick. The B21g horizon is grayish brown (10YR 5/2) or gray (10YR 5/1) and is sand or loamy sand. The IICg horizon is gray (10YR 5/1), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2) and is loam, silty clay loam, or clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Brevort soils formed in the same kind of material as Iosco and Menominee soils. They are grayer in the B horizon than Iosco soils. They have mottles in the solum that are lacking in Menominee soils. Brevort soils have drainage similar to that of the Breckenridge and Granby soils. They dominantly have a coarser texture in the solum than Breckenridge soils. They have a finer texture in the C horizon than Granby soils.

Brevort loamy sand (0 to 2 percent slopes) (Bv).—This soil is in depressions and on broad flats. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the somewhat poorly drained Iosco soils, at slightly higher elevations. Also included are a few areas in which thin layers of sandy loam or sandy clay loam occur in the sandy material above the underlying clay loam. In a few areas the underlying material is stratified silt loam and very fine sand. Also included are a few areas that are gravelly throughout.

This soil is susceptible to soil blowing if the surface is exposed. The main concern of management is removing excess water, but control of soil blowing, conserving moisture, and improving and maintaining fertility are also important.

Most areas of this soil are used for crops. A few areas remain wooded or are used for pasture. This soil is moderately suited to farming if excess water is removed and fertility is maintained. It has severe limitations for recreational and urban developments. Capability unit IIIw-9 (4/2c); woodland suitability group W; recreation group 4.

Brookston Series

The Brookston series consists of poorly drained, nearly level soils on till plains and moraines. These soils formed in loamy glacial till. The native vegetation consisted mainly of elm, ash, soft maple, and swamp white oak.

In a representative profile the surface layer is very dark brown loam about 13 inches thick. The upper 4 inches of the subsoil is light brownish-gray, firm clay loam mottled with dark yellowish brown; the lower 25 inches is grayish-brown, firm heavy clay loam mottled with dark yellowish brown. The underlying material, beginning at a depth of 42 inches, is light brownish-gray heavy loam mottled with yellowish brown (fig. 5).

Permeability is moderately slow, the available water capacity is high, and fertility is high. Surface runoff is very slow or ponded.

Brookston soils are well suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are in woodland.

Representative profile of Brookston loam:

Ap—0 to 10 inches, very dark brown (10YR 2/2) loam; moderate, medium, granular structure; friable; less than 5 percent coarse fragments; neutral; abrupt, smooth boundary.

A12—10 to 13 inches, very dark brown (10YR 2/2) heavy loam; weak, fine, subangular blocky structure; friable; less than 5 percent coarse fragments; neutral; clear, wavy boundary.

B21tg—13 to 17 inches; light brownish-gray (10YR 6/2) clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; strong, medium, subangular blocky structure; firm; very dark brown (10YR 2/2) clay-organic films on surfaces of ped faces; less than 5 percent coarse fragments; mildly alkaline; clear, wavy boundary.

B22tg—17 to 42 inches, grayish-brown (10YR 5/2) clay loam; many, coarse, distinct, dark yellowish-brown (10YR 4/4) mottles; strong, coarse, subangular blocky structure; firm; dark-gray (10YR 4/1) clay films on surfaces of many peds; 5 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

Cg—42 to 60 inches, light brownish-gray (10YR 6/2) heavy loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; 10 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 30 to 50 inches in thickness and is slightly acid to mildly alkaline throughout. The Ap horizon is black (10YR 2/1), dark gray (10YR 3/1), or very dark brown (10YR 2/2) and is 10 to 14 inches thick. The Bg horizon is gray (10YR 5/1), dark gray (10YR 4/1), light brownish gray (10YR 6/2), or grayish brown (10YR 5/2) and is clay loam or silty clay loam. The Cg horizon is loam, heavy loam, or light clay loam. It is mildly alkaline or moderately alkaline and has slight to strong effervescence.

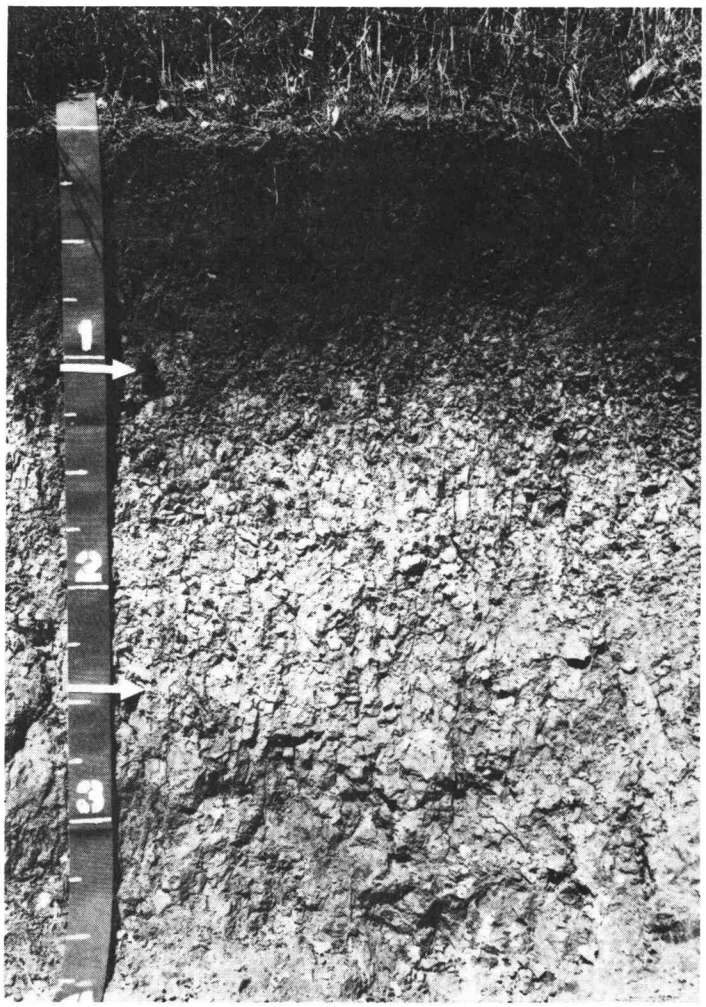

Figure 5.—**Profile of Brookston loam. The thick, dark-colored surface layer and gray subsoil are typical of Brookston soils. The grayish colors of the subsoil indicate that this soil has been wet for long periods of time. The numbers indicate depth in feet.**

Brookston soils formed in the same kind of material as Celina, Conover, and Miami soils. They differ from Celina soils in having mottles in the upper part of the Bt horizon. They have a thicker, dark-colored A horizon than Conover soils. Brookston soils have mottles in the solum that are lacking in Miami soils. These soils have drainage similar to that of Barry soils, bedrock variant, and Barry, Berville, Colwood, and Lenawee soils. They are deeper to bedrock than Barry soils, bedrock variant. They have less sand separates throughout than Barry soils. They lack the gravelly texture in the Bt horizon that is in the Berville soils. Brookston soils lack the stratified material in the C horizon that is in the Colwood and Lenawee soils. These soils have coarse fragments in the profile, which are lacking in Colwood and Lenawee soils.

Brookston loam (0 to 2 percent slopes) (Bw).—This soil is in depressions, in swales, and on broad flats. The areas are small to large in size.

Included with this soil in mapping are small areas of the somewhat poorly drained Conover soils, at slightly higher elevations, and small areas of the poorly drained Brevort soils. Also included are a few areas that have

stones or cobblestones on the surface and small depressed areas that have a surface layer of muck.

This soil is ponded in some areas early in spring and after heavy rains. Permeability is moderately slow. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas are wooded. This soil is well suited to farming if excess water is removed. It has severe limitations for most recreational and urban developments. Capability unit IIw-4 (2.5c); woodland suitability group P; recreation group 4.

Carlisle Series

The Carlisle series consists of very poorly drained, nearly level soils on till plains, outwash plains, and moraines. These soils formed in organic deposits, 42 inches or more thick, that consisted largely of woody material, reeds, sedges, and grasses. The native vegetation consisted mainly of ash, elm, soft maple, aspen, and alder.

In a representative profile the surface layer is black muck about 8 inches thick. This layer contains small, partly decomposed, woody fragments. The second and third layers are dark reddish-brown, friable muck about 39 inches thick. The underlying material, beginning at a depth of 46 inches, is dark reddish-brown mucky peat.

Permeability is moderately rapid, the available water capacity is very high, and fertility is low. Phosphorus, potassium, and many micronutrients are commonly in short supply. Surface runoff is very slow or ponded.

Carlisle soils are well suited to celery, mint, carrots, onions, and other specialty crops if carefully managed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are very severe. These soils are generally poorly suited to woodland.

Many areas of these soils are cultivated. Corn is the main field crop.

Representative profile of Carlisle muck:

1—0 to 8 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; common partly decomposed wood fragments; neutral.

2—8 to 31 inches, dark reddish-brown (5YR 2/2) muck; weak, coarse, granular structure; friable; neutral.

3—31 to 46 inches, dark reddish-brown (5YR 3/2) muck; massive; friable; slightly acid.

4—46 to 60 inches, dark reddish-brown (5YR 3/4) mucky peat; coarse, fibrous; platy structure; neutral.

The organic material is 42 inches or more thick. The profile is slightly acid or neutral throughout. Content of woody fragments ranges from few to many in the upper 36 inches. In a few places a log, as much as 24 inches in diameter, is in the profile. The first horizon is about 6 to 15 inches thick. The second horizon is black (5YR or 10YR 2/1), dark reddish brown (5YR 2/2, 3/2, 3/3, or 3/4), or brown (7.5YR 4/2). The third and fourth horizons are dark reddish brown (5YR 3/2, 3/3, or 3/4), black (5YR 2/1 or 10YR 2/1), very dark brown (10YR 2/2), or dark brown (7.5YR 3/2) or very dark grayish brown (10YR 3/2).

Carlisle soils have drainage similar to that of Edwards, Linwood, Tawas, and Wallkill soils. Carlisle soils lack the marl at a depth of less than 42 inches that is in the Edwards soils. They lack mineral material at a depth of less than 42 inches that is typical of Linwood and Tawas soils. Carlisle soils lack mineral material, 10 inches or more thick, immediately above the organic material that is in the Wallkill soils.

Carlisle muck (0 to 2 percent slopes) (Cg).—This soil is in depressions on lake plains, outwash plains, and moraines. The areas are small to large in size and irregular in shape. Included with this soil in mapping in narrow areas along the edges of this soil are areas of Tawas and Linwood soils.

This soil is very susceptible to soil blowing if the surface is exposed. Permeability is moderately rapid. Fertility is low. Frost damage early in spring and in fall is a hazard. The main concern of management is removal of excess water, but control of soil blowing, preventing frost damage, and improving and maintaining fertility are also important.

Many areas of this soil are cultivated. This soil is well suited to vegetables, commercial sod production, corn, sugar beets, soybeans, and forage crops if carefully managed. It has very severe limitations for recreational and urban developments. Capability unit IIIw-15 (Mc); woodland suitability group J; recreation group 7.

Celina Series

The Celina series consists of moderately well drained, gently undulating soils on till plains and low moraines. These soils formed in loamy glacial till. The native vegetation consisted mainly of oak, maple, beech, hickory, and ash.

In a representative profile the surface layer is dark grayish-brown loam about 10 inches thick. The subsurface layer is brown loam about 5 inches thick. The upper 7 inches of the subsoil is brown, firm clay loam; the lower 8 inches is yellowish-brown, firm clay loam mottled with gray. The underlying material, beginning at a depth of about 30 inches, is grayish-brown heavy loam mottled with yellowish brown.

Permeability is moderately slow, the available water capacity is high, and fertility is high. Surface runoff is slow to medium.

Celina soils are well suited to farming. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are slight to moderate. These soils are well suited to hardwoods but poorly suited to pines.

Most areas of these soils are used for crops. A few areas remain in woodland.

Representative profile of a Celina loam:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; less than 5 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—10 to 15 inches, brown (10YR 5/3) loam; weak, coarse, granular structure; friable; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B21t—15 to 22 inches, brown (10YR 5/3) clay loam; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; medium acid; gradual, wavy boundary.

B22t—22 to 30 inches, yellowish-brown (10YR 5/4) clay loam; many, medium, distinct, gray (10YR 5/1) mottles; moderate, coarse, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; slightly acid; abrupt, wavy boundary.

C—30 to 60 inches, grayish-brown (10YR 5/2) heavy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; massive; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness and is medium acid to mildly alkaline throughout. Depth to mottling ranges from 16 to 28 inches. The A1 horizon, where present, is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The Ap horizon is 8 to 10 inches thick. The A2 horizon is lacking in a few places. The Bt horizon is clay loam or silty clay loam. The C horizon is loam, silt loam, or light clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The Bt horizon of these soils has a lower average content of clay than is defined as the range for the series, and this difference alters the usefulness and behavior of these soils for many farm and nonfarm uses.

Celina soils formed in the same kind of material as Brookston, Conover, and Miami soils. Celina soils lack the mottles in the upper part of the Bt horizon that are in the Brookston and Conover soils. They have mottles in the lower part of the Bt horizon that are lacking in Miami soils.

Celina loam, 2 to 6 percent slopes (ChB).—This soil is on knolls, ridges, and low mounds. The areas are small to large in size and irregular in shape. Slopes are less than 100 feet long. This soil has the profile described as representative of the series.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash material. Also included are a few small eroded areas, at higher elevations, that are the source of the overwash materials. These eroded areas have a browner surface layer than this soil. Also included are a few areas where the surface layer is sandy loam. A few small wet areas and a few areas in drainageways are other inclusions.

The hazard of erosion is slight to moderate. Permeability is moderately slow. The main concern of management is controlling water erosion, but removing excess water in small depressions and drainageways where needed is also a concern.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming. It has slight to moderate limitations for recreational and urban developments. Capability unit IIe-2 (2.5a); woodland suitability group D; recreation group 2.

Celina loam, 2 to 6 percent slopes, moderately eroded (ChB2).—This soil is on knolls, ridges, and low mounds. The areas are small to medium in size and irregular in shape. Slopes are less than 100 feet long. This soil has a profile similar to that described as representative of the series, except that in most places the present surface layer is a mixture of the original surface and subsurface layers and the upper part of the subsoil as a result of erosion. The present surface layer is grayish brown or brown.

Included with this soil in mapping are small areas, especially at higher elevations, where the surface layer is heavy loam or clay loam. Also included are small areas of Brookston soils in depressions and drainageways and moderately well drained Tuscola soils in some areas.

The hazard of erosion is moderate. Permeability is moderately slow. The main concern of management is controlling erosion, but improving of tilth and organic-matter content and removing excess water from seepy areas and drainageways are also concerns.

Most areas of this soil are used for crops. This soil is well suited to farming. It has slight to moderate limitations for recreational and urban developments. Capability unit IIe-2 (2.5a); woodland suitability group D; recreation group 2.

Ceresco Series

The Ceresco series consists of somewhat poorly drained, nearly level soils on flood plains of major streams and rivers. These soils formed in sandy loam water-laid materials. The native vegetation consisted mainly of elm, ash, and cottonwood.

In a representative profile the surface layer is very dark gray loam about 7 inches thick. The upper 17 inches of the subsoil is dark grayish-brown, very friable fine sandy loam mottled with grayish brown and yellowish brown; the lower 10 inches is dark brown, friable sandy loam mottled with gray and yellowish brown. The underlying material, beginning at a depth of about 34 inches, is light brownish-gray light sandy loam mottled with yellowish brown and light olive brown.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. Surface runoff is slow. These soils are susceptible to flooding in spring and after heavy rains.

Ceresco soils are well suited to openland wildlife habitat and moderately suited to woodland and wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils remain in woodland or are used for pasture. A few areas are used for crops.

Representative profile of Ceresco loam:

Ap—0 to 7 inches, very dark gray (10YR 3/1) light loam; weak, fine, granular structure; very friable; mildly alkaline; abrupt, smooth boundary.

B21—7 to 24 inches, dark grayish-brown (10YR 4/2) fine sandy loam; common, medium, distinct, grayish-brown (10YR 5/2) and yellowish-brown (10YR 5/8) mottles; weak, fine, granular structure; very friable; mildly alkaline; gradual, wavy boundary.

B22—24 to 34 inches, dark-brown (10YR 4/3) sandy loam; common, medium, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/6) mottles; weak, fine, subangular blocky structure; friable; mildly alkaline; gradual, wavy boundary.

Cg—34 to 60 inches, light brownish-gray (2.5Y 6/2) light sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) and light olive-brown (2.5Y 5/4) mottles; massive; friable; mildly alkaline; slight effervescence.

The A horizon is dark grayish brown (10YR 4/2) or very dark gray (10YR 3/1) and is mildly alkaline or neutral. The A1 horizon, where present, is 4 to 6 inches thick. The Ap horizon is 7 to 10 inches thick. The B horizon has thin strata of loamy sand in a few profiles. It has thin strata of black organic material in a few profiles. The B horizon is mildly alkaline or neutral. The Cg horizon has thin strata of sand, loamy sand, and loam in a few places. It is mildly alkaline or moderately alkaline and has slight effervescence.

The dark-colored surface layer of these soils is thinner than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Ceresco soils formed in the same kind of material as Cohoctah and Landes soils. These soils lack gray or grayish matrix colors throughout the B horizon that are in the Cohoctah soils. They have gray or grayish matrix colors and mottles in the upper part of the subhorizons that are lacking in Landes soils. Ceresco soils are similar to the Shoals soils. They have a coarser texture in the subhorizons than Shoals soils.

Ceresco loam (0 to 2 percent slopes) (Cm).—This soil is on the flood plains of the major streams and rivers. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of

the poorly drained Cohoctah soils. Also included are small areas where the surface layer is sandy loam.

This soil is high enough above the river that it is flooded most years in spring, but only once in 3 or 4 years during the growing season. The main concerns of management are removal of excess water and flooding, but lack of suitable outlets for drainage and preventing frost damage are also important.

Most areas of this soil are used for woodland or pasture. This soil is not well suited to cultivation because of wetness and the hazard of flooding. A few areas are used for forage crops. Meandering streams, which are associated with this soil, cause many areas to be too small to farm. This soil has severe limitations for recreational and urban developments. Capability unit Vw-3 (L-2c); woodland suitability group O; recreation group 6.

Cohoctah Series

The Cohoctah series consists of poorly drained, nearly level soils on the flood plains of major streams and rivers. These soils formed in sandy loam water-laid materials. The native vegetation consisted mainly of elm, ash, swamp white oak, and red maple.

In a representative profile the surface layer is very dark grayish-brown loam about 8 inches thick. The upper 10 inches of the subsoil is gray, friable sandy loam mottled with dark brown; and the lower 10 inches is grayish-brown, friable sandy loam mottled with yellowish brown. The underlying material, beginning at a depth of about 28 inches, is gray sandy loam mottled with dark yellowish brown.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. Surface runoff is very slow or ponded. These soils are flooded during the growing season in most years.

Cohoctah soils are poorly suited to farming because of a high water table, lack of drainage outlets, flooding, and frost hazard. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are in woodland, unimproved pasture, or wildlife habitat. A few areas are used for crops.

Representative profile of Cohoctah loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

B21g—8 to 18 inches, gray (10YR 5/1) sandy loam; few, fine, distinct, dark-brown (7.5YR 3/2) mottles; weak, fine, subangular blocky structure; friable; neutral; gradual, wavy boundary.

B22g—18 to 28 inches, grayish-brown (10YR 5/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/4) mottles; massive; friable; neutral; gradual, wavy boundary.

Cg—28 to 60 inches, gray (10YR 5/1) sandy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; friable; mildly alkaline.

The solum ranges from slightly acid to mildly alkaline throughout. The Ap horizon is very dark brown (10YR 2/2), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1) and is 6 to 10 inches thick. The Bg and Cg horizons contain strata of loam and loamy sand in a few places. The thickness of the strata varies considerably within short distances. In a few places the Bg and Cg horizons contain thin layers of black (10YR 2/1) organic material. The Cg horizon is mildly alkaline or moderately alkaline. It has slight effervescence in a few places.

The dark-colored surface layer of these soils is thinner than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Cohoctah soils formed in the same kind of material as Ceresco and Landes soils. These soils have gray or grayish matrix colors throughout the B horizon that are lacking in Ceresco soils. They lack the brighter colors in the subhorizons that are in the Landes soils. Cohoctah soils are similar to Glendora and Sloan soils. They dominantly have a finer texture in the subhorizons than Glendora soils. They dominantly have a coarser texture than Sloan soils.

Cohoctah loam (0 to 2 percent slopes) (Cn).—This soil is on the flood plains of major streams and rivers. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the somewhat poorly drained Ceresco soils. Also included are areas that have a surface layer of silt loam or sandy loam.

This soil is near enough to the level of the stream that it is flooded during the growing season in most years. The main concerns of management are removal of excess water, lack of suitable outlets for drainage, flooding, and preventing frost damage.

Most areas of this soil are used for woodland and pasture. This soil is not suited to crops in most areas, because of wetness unless streams are straightened and deepened so that drainage outlets are available. It has severe limitations for recreational and urban developments. Capability unit Vw-3 (L-2c); woodland suitability group O; recreation group 6.

Colwood Series

The Colwood series consists of poorly drained, nearly level soils on lake plains and outwash plains. These soils formed in water-laid materials consisting of stratified silt loam and fine and very fine sand. The native vegetation consisted mainly of soft maple, ash, elm, and alder.

In a representative profile the surface layer is very dark brown loam about 12 inches thick. The upper 7 inches of the subsoil is light brownish-gray, friable heavy loam with yellow mottles; the lower 19 inches is gray, friable light sandy clay loam mottled with brownish yellow. The underlying material, beginning at a depth of about 38 inches, is light-gray, stratified very fine sand, fine sand, and silt loam mottled with brownish yellow and yellowish brown.

Permeability is moderate, the available water capacity is high, and fertility is high. Surface runoff is very slow or ponded.

Colwood soils are well suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for woodland.

Representative profile of Colwood loam:

Ap—0 to 7 inches, very dark brown (10YR 2/2) loam; weak, fine, granular structure; friable; mildly alkaline; abrupt, smooth boundary.

A12—7 to 12 inches, very dark brown (10YR 2/2) loam; weak, medium, granular structure; friable; mildly alkaline; clear, wavy boundary.

B21g—12 to 19 inches, light brownish-gray (10YR 6/2) heavy loam; common, fine, distinct, yellow (10YR 7/6) mottles; moderate, medium, subangular blocky structure; friable; neutral; clear, wavy boundary.

IIB22g—19 to 38 inches, gray (10YR 6/1) light sandy clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, coarse, subangular blocky structure; friable; neutral; abrupt, wavy boundary.

IIICg—38 to 60 inches, light-gray (10YR 7/2) stratified very fine sand, fine sand, and silt loam; common, medium, distinct, brownish-yellow (10YR 6/8) and yellowish-brown (10YR 5/4) mottles; massive; friable; mildly alkaline; slight effervescence.

The solum ranges from 30 to 50 inches in thickness and from slightly acid to mildly alkaline throughout. The Ap horizon is black (10YR 2/1) or very dark brown (10YR 2/2). The Bg horizon is heavy fine sandy loam, heavy loam, light sandy clay loam, or light silty clay loam. The IIICg horizon is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Colwood soils formed in the same kind of material as Kibbie and Tuscola soils. These soils have a thicker, dark-colored A horizon than Kibbie soils. They have dominantly gray or grayish matrix colors in the subhorizons that are lacking in Tuscola soils, and they typically have a darker colored Ap horizon than those soils. Colwood soils have drainage similar to that of Breckenridge, Brookston, Lenawee, and Wallkill soils. They have stratified material in the C horizon that is lacking in Breckenridge and Brookston soils, and they lack the coarse fragments in the profile that are typical of those soils. They dominantly have a coarser texture throughout than Lenawee soils. They lack the organic material, at depths between 10 and 40 inches, that is in the Wallkill soils.

Colwood loam (0 to 2 percent slopes) (Cs).—This soil is in depressions and swales. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the somewhat poorly drained Kibbie soils at slightly higher elevations, and small, depressional areas of the poorly drained Lenawee soils. Also included are a few areas where the surface layer is muck or fine sandy loam.

This soil is commonly ponded in some low depressions in spring and after heavy rains. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas are wooded. This soil is well suited to farming if excess water is removed. It has severe limitations for recreational and urban developments. Capability unit IIw-6 (2.5c); woodland suitability group W; recreation group 4.

Conover Series

The Conover series consists of somewhat poorly drained, nearly level to gently sloping soils on till plains and low moraines. These soils formed in loamy glacial till. The native vegetation consisted mainly of oak, maple, hickory, and ash.

In a representative profile the surface layer is very dark gray loam about 9 inches thick. The subsurface layer is brown loam about 4 inches thick. The upper 6 inches of the subsoil is light brownish-gray, firm clay loam mottled with dark yellowish brown; the lower 17 inches is pale-brown, firm clay loam mottled with yellowish brown. The underlying material, beginning at a depth of about 36 inches, is light brownish-gray heavy loam mottled with yellowish brown (fig. 6).

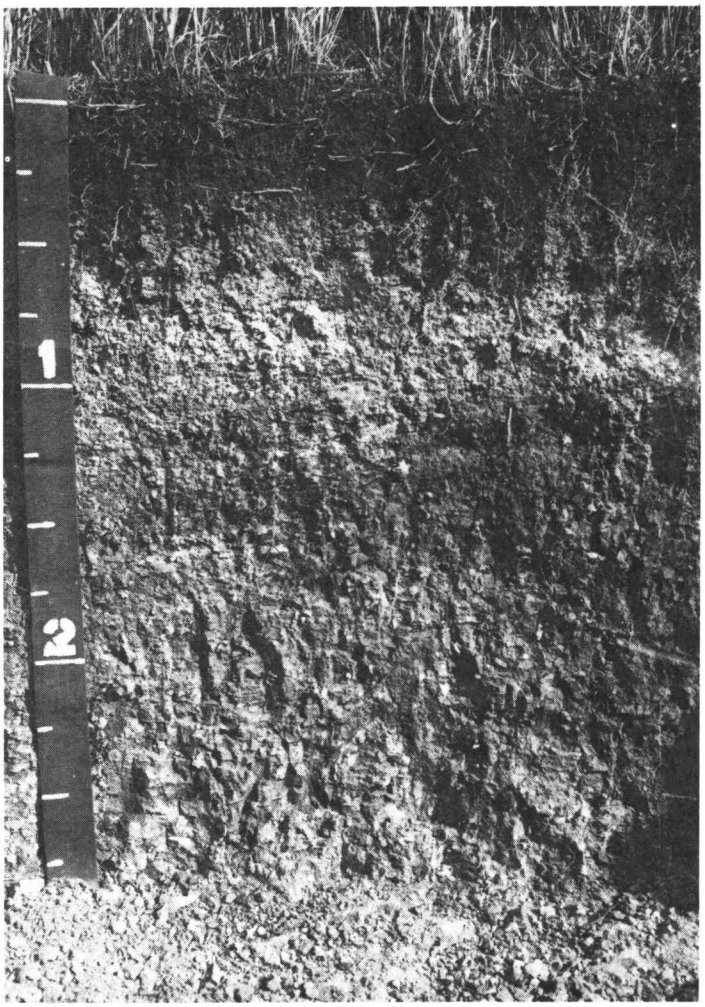

Figure 6.—**Profile of Conover loam. The thin subsurface layer is grayish brown when dry. The subsoil is blocky and firm. The numbers indicate depth in feet.**

Permeability is moderately slow, the available water capacity is high, and fertility is high. Surface runoff is slow to medium.

Conover soils are well suited to farming if excess water is removed. They are well suited to openland wildlife. Limitations for many nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas remain in woodland.

Representative profile of a Conover loam:

Ap—0 to 9 inches, very dark gray (10YR 3/1) loam; weak, medium, granular structure; friable; less than 5 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—9 to 13 inches, brown (10YR 5/3) loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, medium, platy structure; friable; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B21tg—13 to 19 inches, light brownish-gray (10YR 6/2) clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, subangular blocky structure; firm; clay films on sur-

faces of many peds; 5 percent coarse fragments; slightly acid; gradual, wavy boundary.

B22t—19 to 36 inches, pale-brown (10YR 6/3) clay loam; many, coarse, distinct, yellowish-brown (10YR 5/6) mottles; moderate, coarse, subangular blocky structure; firm; gray (10YR 5/1) clay films on surfaces of peds; 5 percent coarse fragments; slightly acid; abrupt, wavy boundary.

Cg—36 to 60 inches, light brownish-gray (10YR 6/2) heavy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, coarse, subangular blocky structure; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 25 to about 40 inches in thickness and is slightly acid or neutral throughout. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 7 to 9 inches thick. The A2 horizon is brown (10YR 5/3) or pale brown (10YR 6/3) and is 2 to 5 inches thick. Mottles of yellowish brown (10YR 5/4, 5/6, or 5/8), grayish brown (10YR 5/2), or light grayish brown (10YR 6/2) are in this horizon. In a few places the A2 horizon is mixed into the Ap horizon by plowing. The B horizon is light brownish gray (10YR 6/2), pale brown (10YR 6/3), or brown (10YR 5/3) and is clay loam or silty clay loam. The C horizon is light brownish gray (10YR 6/2), brown (10YR 5/3), or grayish-brown (10YR 5/2) and is heavy loam or light clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence.

Conover soils formed in the same kind of material as Brookston, Celina, and Miami soils. These soils have a thinner, dark-colored A horizon than the Brookston soils. They have mottles in the upper part of the Bt horizon that are lacking in Celina soils. They have mottles in the solum that are lacking in Miami soils. Conover soils are similar to Belding, Macomb, and Metamora soils. They have a finer texture in the upper part of the profile than Belding soils. These soils lack the gravelly soil material in all or part of the B horizon that is in the Macomb soils. They have a finer texture in the upper part of the solum in the subhorizons than Metamora soils.

Conover loam, 0 to 2 percent slopes (CtA).—This soil is in broad flat areas. The areas are small to large in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of poorly drained Brookston soils in depressions and narrow drainageways. Also included are some small areas where the surface layer and subsoil are sand or loamy sand. Other inclusions are small areas where the surface layer is sandy loam or silt loam.

Surface runoff is slow, and the hazard of erosion is slight. Permeability is moderately slow. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. This soil is well suited to farming if excess water is removed and tilth is maintained. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-4 (2.5b); woodland suitability group Z; recreation group 3.

Conover loam, 2 to 6 percent slopes (CtB).—This soil is on low knolls, ridges, and slopes along drainageways. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of poorly drained Brookston soils in depressions and narrow drainageways. Also included are areas of depressional soils that have a surface layer of muck. Other inclusions are a few small areas of eroded soils that have a surface layer of brownish clay loam. In the included eroded areas the slope is 4 to 6 percent.

Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderately slow. The main concern of management is removing excess water, but controlling erosion is also a concern.

Most areas of this soil are used for crops. Some areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-5 (2.5b); woodland suitability group Z; recreation group 3.

Edwards Series

The Edwards series consists of very poorly drained, nearly level soils in depressions on lake plains, glacial drainageways, and moraines. These soils formed in organic materials, 12 to 42 inches thick, over marl. The native vegetation consisted mainly of elm, soft maple, and aspen.

In a representative profile the upper 20 inches is black muck. Below this, the underlying material is white marl.

Permeability is moderately rapid in the organic material and variable in the marl. The available water capacity is very high, and fertility is low. Surface runoff is very slow or ponded.

Edwards soils generally are poorly suited to farming. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils remain wooded or are in native pasture. A few areas are used for crops.

Representative profile of Edwards muck:

1—0 to 12 inches, black (10YR 2/1) muck; weak, fine, granular structure; friable; mildly alkaline.

2—12 to 20 inches, black (5YR 2/1) muck; weak, coarse, granular structure; friable; mildly alkaline.

IIC—20 to 42 inches, white (10YR 8/2) marl; massive, friable; moderately alkaline; violent effervescence.

The organic material is 12 to 42 inches thick over marl. It is mildly alkaline or neutral throughout. The first horizon is very dark brown (10YR 2/2) or black (10YR 2/1). The second horizon is very dark gray (10YR 3/1), black (5YR 2/1 or 10YR 2/1), or dark reddish brown (5YR 3/2, 3/3, or 3/4). The IIC horizon is light gray (10YR 7/1 or 7/2), pinkish white (7.5YR 8/2), or white (10YR 8/1 or 8/2). The IIC horizon is moderately alkaline and has violent effervescence.

Edwards soils are similar to Carlisle, Linwood, and Tawas soils. They have thinner organic deposits than Carlisle soils. They have marl in the profile, but Linwood soils have loamy material and Tawas soils have sandy material.

Edwards muck (0 to 2 percent slopes) (Ek).—This soil is on swampy flats on lake plains, in drainageways, and in shallow depressions and swales on uplands. The areas are small to medium in size and irregular in shape. Most areas occur as narrow, marginal areas around lakes or around areas of Tawas or Carlisle soils.

Included with this soil in mapping are small areas where the organic material is less than 12 inches thick. Also included are some areas where the marl is underlain, at depths of 20 to 35 inches, by sand or gravelly sand. Small areas of Tawas or Carlisle soils are also included.

This soil is very susceptible to soil blowing if the surface is exposed. Fertility is low, and micronutrients are in short supply. The main concerns of management are removing excess water, control of soil blowing, low fertility, and the shallowness to marl. Preventing frost damage is also important.

Most areas of this soil are in woodland or native pasture. A few areas are used for crops. This soil is poorly suited to farming. It has very severe limitations for recreational and urban developments. Capability unit IVw-6 (M/mc); woodland suitability group J; recreation group 7.

Eel Series

The Eel series consists of moderately well drained, nearly level soils on flood plains of major streams in the county. These soils formed in loamy water-laid materials. In this county Eel soils are mapped in an undifferentiated unit with Abscota and Landes soils. The native vegetation consisted mainly of beech, elm, hickory, sugar maple, and oak.

In a representative profile the surface layer is dark grayish-brown loam about 10 inches thick. The upper 12 inches of the subsoil is brown, friable loam; the lower 8 inches is dark-brown, friable loam mottled with gray. The underlying material, beginning at a depth of about 30 inches, is light brownish-gray heavy loam mottled with dark yellowish brown.

Permeability is moderate, the available water capacity is high, and fertility is high. These soils are seldom flooded after May. Surface runoff is slow.

Eel soils are seldom used for crops, because of susceptibility to flooding and because the areas are small and isolated. They are well suited to openland and woodland wildlife habitat. Limitations for many nonfarm uses are moderate to severe. These soils are moderately suited to woodland.

Most areas of these soils are used for recreation or they are idle, wooded, or in brush. A few areas are used for crops.

Representative profile of Eel loam, from an area of Eel, Landes, and Abscota soils:

Ap—0 to 10 inches, dark grayish-brown (10YR 4/2) loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

B21—10 to 22 inches, brown (10YR 5/3) loam; weak, coarse, granular structure; friable; slightly acid; gradual, wavy boundary.

B22—22 to 30 inches, dark-brown (10YR 4/3) loam; many, medium, distinct, gray (10YR 5/1) mottles; weak, fine, subangular blocky structure; friable; neutral; gradual, wavy boundary.

Cg—30 to 60 inches, light brownish-gray (10YR 6/2) heavy loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; massive; friable; mildly alkaline.

The solum ranges from 24 to 40 inches in thickness and is slightly acid or mildly alkaline throughout. Depth to mottles is 17 to 28 inches. The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2) and is 8 to 11 inches thick. The B and C horizons are silt loam, loam, light clay loam, or light silty clay loam. These horizons have thin layers of sandy loam or black (10YR 2/1) organic materials, 1 to 4 inches thick, in a few places.

These soils lack effervescent material within a depth of 40 inches, which is in the defined range for the series, but this difference does not alter the usefulness and behavior of these soils.

Eel soils formed in the same kind of material as Shoals and Sloan soils. These soils dominantly have less gray or grayish colors in the B horizon than Shoals and Sloan soils. They have a thinner or lighter colored A horizon than Sloan soils. In this county Eel soils are mapped in an undifferentiated unit with Abscota and Landes soils. They dominantly have a finer texture in the subhorizons than Abscota and Landes soils.

Eel, Landes, and Abscota soils (0 to 2 percent slopes) (En).—These soils are on the flood plains of major rivers and streams. The areas are small in size and irregular in shape. Eel soil makes up about 45 percent of this undifferentiated group; Landes soil, about 33 percent; and Abscota soil, about 22 percent. The Eel soil has a loam surface layer; the Landes and Abscota soils have a sandy loam surface layer.

Included with these soils in mapping are small areas that contain gravelly sand at a depth below 40 inches. Also included are a few small wet areas, especially in old stream channels.

This undifferentiated group is high enough above the streams that it is normally flooded only before the growing season in spring. The available water capacity is low, and fertility is low in Abscota soil. The main concerns of management are moderate frost hazard, occasional flooding, and, in Abscota soil, low soil moisture.

Most areas of this undifferentiated group are small and are used for pasture, woodland, or recreation. Some larger areas are used for crops, but most areas are too small and isolated for this use. Other areas are idle. This undifferentiated group has moderate to severe limitations for recreational and urban developments. Capability unit Vw-3 (L-2a, L-4a); woodland suitability group O; recreation group 6.

Fox Series

The Fox series consists of well-drained, gently sloping to moderately steep soils on outwash plains and moraines. These soils formed in gravelly loam, 24 to 42 inches thick, over gravelly coarse sand. The native vegetation consisted mainly of oaks, maple, hickory, and beech.

In a representative profile the surface layer is dark grayish-brown sandy loam about 7 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The subsurface layer is brown sandy loam about 4 inches thick. The upper 5 inches of the subsoil is dark-brown, friable gravelly loam; the middle 8 inches is yellowish-red, friable gravelly clay loam; the lower 12 inches is reddish-brown, friable gravelly sandy clay loam. The underlying material, beginning at a depth of about 36 inches, is very pale brown gravelly coarse sand.

Permeability is moderate, the available water capacity is moderate, and fertility is medium.

Fox soils are well suited to farming. They are well suited to openland wildlife habitat. Limitations for nonfarm uses are slight on the less sloping soils and moderate to severe on the more sloping soils. These soils are well suited to woodland.

Most areas of the less sloping soils are used for crops. The steeper areas are mostly used for permanent pasture, and a few areas are used for hay or small grain, or are idle.

Representative profile of a Fox sandy loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—7 to 11 inches, brown (10YR 5/3) sandy loam; weak, coarse, granular structure; friable; slightly acid; clear, wavy boundary.

B21t—11 to 16 inches, dark-brown (7.5YR 4/4) gravelly loam; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 20 percent gravel; medium acid; clear, wavy boundary.
B22t—16 to 24 inches, yellowish-red (5YR 4/6) gravelly clay loam; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 20 percent gravel; slightly acid; clear, wavy boundary.
B23t—24 to 36 inches, reddish-brown (5YR 4/4) gravelly sandy clay loam; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 25 percent gravel; mildly alkaline; abrupt, irregular boundary.
IIC—36 to 60 inches, very pale brown (10YR 7/4) gravelly coarse sand; single grain; loose; 30 percent gravel; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness. Cobblestones are in the lower part of the B horizon and in the C horizon in a few places. The A1 horizon, where present, is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The A horizon ranges from strongly acid to slightly acid. The B horizon is dark yellowish brown (10YR 4/4), yellowish red (5YR 4/6), reddish brown (5YR 4/4), dark brown (7.5YR 4/4), or yellowish brown (10YR 5/4, 5/6, or 5/8). It is loam, sandy clay loam, or clay loam and gravelly analogs of these textures. The IIC horizon is yellowish brown (10YR 5/4, 5/6, or 5/8), very pale brown (10YR 7/4), or light yellowish brown (10YR 6/4) and is gravelly coarse sand or very gravelly coarse sand. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

These soils, on the average, have more gravel in the lower part of the solum than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Fox soils formed in the same kind of material as Matherton and Sebewa soils. They lack mottles in the solum that are in the Matherton and Sebewa soils, and they have a thinner or lighter colored A horizon than those soils. Fox soils are similar to Boyer, Kendallville, and Miami soils. On the average, these soils have a higher content of clay in the Bt horizon than Boyer soils. They have a coarser texture in the C horizon than Kendallville and Miami soils. They dominantly average a higher content of coarse fragments in the lower part of the solum than Miami soils.

Fox sandy loam, 2 to 6 percent slopes (FoB).—This soil is on low knolls, ridges on plains, and slopes along drainageways on uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series. Slopes are less than 100 foot long.

Included with this soil in mapping are small areas of poorly drained Sebewa soils in small depressions and narrow drainageways. Also included in some areas are the well-drained Kendallville soils. A few small eroded areas are included at higher elevations. Also included are some areas where the surface layer is loam.

Surface runoff is slow to medium, and the hazard of erosion is slight or moderate. The main concern of management is controlling erosion, but conserving moisture is also a concern.

Most areas of this soil are used for crops. A few areas are used for woodland or pasture. This soil is well suited to farming. It has slight limitations for most recreational and urban developments. Capability unit IIe-3 (3a); woodland suitability group U; recreation group 2.

Fox sandy loam, 6 to 12 percent slopes (FoC).—This soil is on knolls, ridges, and foot slopes on plains and uplands. The areas are small or medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer is lighter brown and is thinner in a few areas because of erosion.

Included with this soil in mapping are small areas of the poorly drained Sebewa soils in small depressions and narrow drainageways. Also included are some areas where cobblestones and gravel are scattered on the surface, but not in sufficient amounts to hinder tillage.

Surface runoff is medium, and the hazard of erosion is moderate. The main concern of management is controlling erosion, but conserving moisture is also a concern.

Most areas of this soil are used for crops. Some areas are wooded, idle, or are used for pasture. This soil is moderately suited to farming. It has moderate limitations for most recreational and urban developments. Capability unit IIIe-6 (3a); woodland suitability group U; recreation group 2.

Fox sandy loam, 12 to 18 percent slopes (FoD).—This soil is on short, convex slopes on uplands and on short slopes adjacent to narrow valleys. The areas are small in size and irregular in shape. Slopes are 50 to 75 feet in length. This soil has a profile similar to the one described as representative of the series, except that the present surface layer is browner and thinner in most places.

Included with this soil in mapping are small eroded areas where the original surface layer has been mixed with the upper part of the subsoil or has been removed through erosion. Also included are small areas of the poorly drained Sebewa soils in small depressions and narrow drainageways.

Surface runoff is rapid, and the hazard of erosion is severe. If this soil is farmed intensively, much of the water from rainfall runs off and little enters the soil to be used by crops. The main concerns of management are controlling erosion, conserving moisture, and implementing conservation practices. This is difficult because of short, complex slopes.

Most areas of this soil are used for permanent pasture. A few areas are used for hay or small grain. This soil is poorly suited to cultivated crops. It has severe limitations for most recreational and urban developments. Capability unit IVe-4 (3a); woodland suitability group U; recreation group 2.

Gilford Series

The Gilford series consists of poorly drained, nearly level soils on outwash plains, lake plains, and glacial drainageways. These soils formed in sandy loam materials, 28 to 40 inches thick, over fine gravelly sand. The native vegetation consisted mainly of swamp white oak, aspen, and soft maple.

In a representative profile the surface layer is black sandy loam about 10 inches thick. The subsurface layer is very dark grayish-brown sandy loam about 4 inches thick. The upper 15 inches of the subsoil is light brownish-gray, friable fine sandy loam mottled with light olive brown, and the lower 7 inches is grayish-brown, friable sandy loam mottled with light olive brown. The underlying material, beginning at a depth of about 36 inches, is light brownish-gray fine gravelly sand.

Permeability is moderately rapid, the available water capacity is low, and fertility is medium. Surface runoff is very slow or ponded.

Gilford soils are moderately suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for pasture or are wooded.

Representative profile of a Gilford sandy loam:

Ap—0 to 10 inches, black (10YR 2/1) sandy loam; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A12—10 to 14 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; neutral; clear, wavy boundary.

B21g—14 to 29 inches, light brownish-gray (2.5Y 6/2) fine sandy loam; common, fine, distinct, light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; friable; very dark grayish-brown (10YR 3/2) organic films on surfaces of peds in upper part; neutral; gradual, wavy boundary.

B22g—29 to 36 inches, grayish-brown (2.5Y 5/2) sandy loam; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; friable; 5 percent fine gravel; mildly alkaline; abrupt, wavy boundary.

IIC—36 to 60 inches, light brownish-gray (2.5Y 6/2) fine gravelly sand; single grain; loose; 30 percent fine gravel; mildly alkaline; slight effervescence.

The solum ranges from 28 to 40 inches in thickness and is slightly acid to mildly alkaline throughout. The Ap horizon is very dark brown (10YR 2/2) or black (10YR 2/1) and is 10 to 16 inches thick. The B horizon is gray (10YR 5/1), light brownish gray (2.5Y or 10YR 6/2), grayish brown (2.5Y to 10YR 5/2), or dark gray (10YR 4/1) and is sandy loam, fine sandy loam, or light sandy clay loam. The IIC horizon is gray (10YR 5/1), grayish brown (2.5Y or 10YR 5/2), or light brownish gray (2.5Y or 10YR 6/2). It is sand or coarse sand and gravelly or very gravelly analogs of these textures. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Gilford soils formed in the same kind of material as Boyer and Wasepi soils. These soils have mottles in the solum that are lacking in Boyer soils. They have a thicker, dark-colored A horizon than Boyer and Wasepi soils. Gilford soils are similar to Barry, Gladwin, Granby, and Sebewa soils. They have gravelly sand in the C horizon that is lacking in Barry soils. They lack the brighter matrix colors in the B horizon that are in the Gladwin soils. Gilford soils have a finer texture in the solum than Granby soils and have a coarser texture in the B horizon than Sebewa soils.

Gilford sandy loam (0 to 2 percent slopes) (Gg).—This soil is in depressions, swales, and drainageways. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the somewhat poorly drained Wasepi soils at slightly higher elevations. Also included are some areas where cobblestones and gravel are on the surface, but not in sufficient quantities to interfere with tillage. Also included are a few small areas that are severely limited for farming because of the numerous stones on the surface and in the subsoil. In addition, several small areas are included where alkaline gravelly sand begins at a depth of less than 24 inches.

This soil is ponded in some areas early in spring and after heavy rains. The main concerns of management are removing excess water and conserving soil moisture in drained areas.

Most of this soil is used for crops. A few areas are in pasture or woodland. This soil is moderately suited to farming if excess water is removed. It has severe limitations for recreational and urban developments. Capability unit IIIw-6 (4c); woodland suitability group W; recreation group 4.

Gilford stony sandy loam (0 to 2 percent slopes) (Gh).—This soil is in old glacial drainageways. The areas are small in size and irregular in shape. Stones, 10 to 20 inches in diameter and 5 to 30 feet apart, are on the surface or within the surface layer. Cobblestones, 3 to 6 inches in diameter, are in many areas in the upper part of the subsoil.

Included with this soil in mapping are a few small, nonstony areas of Gilford sandy loam. Also included are a few small areas where the subsoil is clay loam and is thicker than that of the profile described as representative.

The main concerns of management are removal of excess water and stones.

Most areas of this soil are used for pasture. Some areas remain in woodland. Stones are present in numbers that make tillage of cultivated crops impractical. The soil has severe limitations for recreational and urban developments. Capability unit Vw-1 (4c); woodland suitability group W; recreation group 4.

Gladwin Series

The Gladwin series consists of somewhat poorly drained, nearly level soils on outwash plains, lake plains, and low beach ridges. These soils formed in loamy sand and sandy loam materials, 18 to 42 inches thick, over gravelly sand. The native vegetation consisted mainly of maple, oak, hickory, and beech.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 7 inches thick. The upper 15 inches of the subsoil is dark yellowish-brown, very friable loamy sand mottled with brownish yellow; and the lower 10 inches is dark-brown, friable sandy loam mottled with gray and reddish yellow. The underlying material, beginning at a depth of about 32 inches, is very pale brown gravelly sand.

Permeability is moderately rapid, the available water capacity is low, and fertility is low. Surface runoff is slow.

Gladwin soils are moderately suited to farming if excess water is removed, if the soil is fertilized, and if moisture is conserved. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for woodland, pasture, hay, or small grain. A few areas are used for corn and beans.

Representative profile of Gladwin loamy sand:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

Bir—7 to 22 inches, dark yellowish-brown (10YR 4/4) loamy sand; few, fine, distinct, brownish-yellow (10YR 6/6) mottles; weak, fine, subangular blocky structure; very friable; less than 5 percent gravel; slightly acid; clear, wavy boundary.

Bt—22 to 32 inches, dark-brown (7.5YR 4/4) sandy loam; common, medium, distinct, gray (10YR 5/1) mottles and common, fine, distinct, reddish-yellow

(7.5YR 6/8) mottles; weak, medium, subangular blocky structure; friable; clay films on surfaces of peds; 10 percent fine gravel; neutral; abrupt, wavy boundary.

IIC—32 to 60 inches, very pale brown (10YR 7/4) gravelly sand; single grain; loose; 25 percent fine gravel; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness and from medium acid to mildly alkaline in reaction throughout the profile. The A1 horizon, where present, is very dark brown (10YR 2/2) and is 1 to 4 inches thick. The A2 horizon, where present, is gray (10YR 5/1 or 6/1) and is 2 to 4 inches thick. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 6 to 10 inches thick. The Bt horizon is dark yellowish brown (10YR 4/4), dark brown (7.5YR 4/4), or yellowish brown (10YR 5/4, 5/6, 5/8) and is gravelly sandy loam or sandy loam. It is 6 to 11 inches thick. The IIC horizon is pale brown (10YR 6/3) or very pale brown (10YR 7/4) and is sand or coarse sand or gravelly or very gravelly analogs of these textures. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Gladwin soils formed in the same kind of material as Mancelona soils. These soils have mottles in the solum that are lacking in Mancelona soils. Gladwin soils are similar to Gilford soils. They lack the gray or grayish matrix colors in the B horizon that are in the Gilford soils.

Gladwin loamy sand, 0 to 2 percent slopes (GmA).—This soil is on flats and low ridges. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of poorly drained Gilford soils in depressions. Also included are a few gently sloping areas on ridges and low mounds.

This soil is very susceptible to soil blowing if the surface is exposed. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are removing excess water and conserving moisture.

Most areas of this soil are used for woodland, pasture, hay, or small grain. A few areas are used for row crops. This soil is moderately suited to farming if excess water is removed, if the soil is fertilized, and if moisture is conserved. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIw-5 (4b); woodland suitability group G; recreation group 5.

Glendora Series

The Glendora series consists of poorly drained, nearly level soils on flood plains of the larger streams and rivers. These soils formed in sandy water-laid materials. The native vegetation consisted mainly of elm, ash, swamp white oak, and aspen.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The upper 6 inches of the subsoil is dark grayish-brown, very friable loamy sand mottled with olive brown; the lower 4 inches is gray, loose loamy sand mottled with dark brown. The underlying material, beginning at a depth of about 18 inches, is gray sand.

Permeability is rapid, the available water capacity is low, and fertility is low. Surface runoff is very slow or ponded. These soils are flooded during the growing season in most years.

Glendora soils are very poorly suited to farming. They are moderately well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for woodland or unimproved pasture. A few areas are used for crops.

Representative profile of Glendora sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B21g—8 to 14 inches, dark grayish-brown (10YR 4/2) loamy sand; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; weak, medium, subangular blocky structure; very friable; mildly alkaline; gradual, wavy boundary.

B22g—14 to 18 inches, gray (10YR 5/1) loamy sand; common, medium, distinct, dark-brown (7.5YR 4/4) mottles; single grain; loose; mildly alkaline; clear, wavy boundary.

Cg—18 to 60 inches, gray (10YR 6/1) sand; single grain; loose; mildly alkaline; slight effervescence.

The solum ranges from slightly acid to mildly alkaline throughout. The A1 horizon, where present, is black (10YR 2/1) or very dark brown (10YR 2/2). The Ap horizon is 8 to 10 inches thick. The Cg horizon is mildly alkaline or moderately alkaline and has slight or strong effervescence.

Glendora soils formed in the same kind of material as Abscota and Algansee soils. These soils have mottles immediately beneath the Ap horizon, which are lacking in Abscota soils. They are dominantly more gray in the subhorizons than Algansee soils. Glendora soils are similar to Cohoctah and Sloan soils. They dominantly have a coarser texture in the subhorizons than Cohoctah and Sloan soils.

Glendora sandy loam (0 to 2 percent slopes) (Gn).—This soil is on flood plains of the larger streams and rivers. The areas are small in size and irregular in shape.

Included with this soil in mapping are small areas of the somewhat poorly drained Algansee soils. Also included are a few widely scattered areas where the surface layer is loamy sand, loam, or silt loam.

Flooding occurs during the growing season in most years. Permeability is rapid, the available water capacity is low, and fertility is low. The main concerns of management are removing excess water, difficulty of obtaining suitable outlets, flooding, conserving moisture, and improving and maintaining fertility.

Most areas of this soil are used for woodland or unimproved pasture. A few areas are cultivated. This soil is very poorly suited to farming, but it is suitable for pasture. It has very severe limitations for recreational and urban developments. Capability unit VIIw-1 (L-4c); woodland suitability group O; recreation group 6.

Granby Series

The Granby series consists of poorly drained, nearly level soils on outwash plains and lake plains. These soils formed in sandy materials. The native vegetation consisted mainly of aspen, oak, soft maple, and elm.

In a representative profile the surface layer is black loamy sand about 9 inches thick. The subsoil is light-gray, very friable loamy sand about 3 inches thick. The underlying material, beginning at a depth of about 12 inches, is light brownish-gray sand mottled with yellowish brown.

Permeability is rapid, the available water capacity is low, and fertility is low. Surface runoff is very slow or ponded.

Granby soils are generally moderately well suited to farming if excess water is removed, if the soil is adequately fertilized, and if moisture is conserved. They are suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for permanent pasture or woodland. A few areas are used for crops.

Representative profile of Granby loamy sand:

Ap—0 to 9 inches, black (10YR 2/1) loamy sand; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

Bg—9 to 12 inches, light-gray (10YR 7/2) loamy sand; weak, coarse, granular structure; very friable; dark-gray (10YR 4/1) organic films on surfaces of peds; neutral; clear, wavy boundary.

C—12 to 60 inches, light brownish-gray (10YR 6/2) sand; few, medium, distinct, yellowish-brown (10YR 5/6) mottles; single grain; loose; mildly alkaline.

The profile is neutral or mildly alkaline throughout. The A horizon is black (10YR 2/1) or very dark brown (10YR 2/2) and is 7 to 14 inches thick. The C horizon is gray (10YR 5/1), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). It has slight effervescence between depths of 40 and 60 inches in a few places.

The dark-colored surface layer of these soils is thinner than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Granby soils formed in the same kind of material as Plainfield soils, slightly acid variant. These soils dominantly have gray or grayish matrix colors in the solum that are lacking in Plainfield soils, slightly acid variant. Granby soils have drainage similar to that of Brevort and Gilford soils. They have a coarser texture in the C horizon than Brevort soils and have a coarser texture in the solum than Gilford soils.

Granby loamy sand (0 to 2 percent slopes) (Go).—This soil is in depressions, swales, and drainageways. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are a few small areas of the poorly drained Gilford soils. Also included are some areas where the surface layer is sandy loam.

This soil is susceptible to soil blowing if the surface is exposed. Permeability is rapid, the available water capacity is low, and fertility is low. The main concerns of management are removing excess water, conserving moisture after drainage, and controlling soil blowing.

Most areas of this soil are used for permanent pasture or woodland. A few areas are used for row crops. This soil is moderately suited to farming if excess water is removed, if it is adequately fertilized, and if moisture is conserved. This soil has severe limitations for recreational and urban developments. Capability unit IIIw-6 (5c); woodland suitability group W; recreation group 4.

Gravel Pits

Gravel pits (Gp) are areas from which the overlying soil layers have been removed or pushed aside so that sand and gravel can be excavated for road construction, concrete mixing, and various other uses. Gravel pits are on sandy moraines and outwash plains and in glacial drainageways throughout the county.

The pits vary considerably in size. Most of the small ones are quarried only occasionally for home use or for small road fills. The larger pits are outlined on the soil map; the smaller pits are indicated by a symbol. Most of the larger pits are or have been commercially operated. The pits ordinarily have no use other than as sources of gravel or sand. Some of them, however, contain water and are used for swimming, fishing, and other recreational activities. Capability unit VIIIs-1 (Sa); not placed in a woodland suitability group or recreation group.

Iosco Series

The Iosco series consists of somewhat poorly drained, nearly level soils on till plains. These soils formed in sandy material, 18 to 42 inches thick, and in the underlying loamy glacial till. The native vegetation consisted mainly of aspen, maple, and oak.

In a representative profile the surface layer is dark-brown loamy sand about 8 inches thick. The upper 7 inches of the subsoil is dark yellowish-brown, very friable loamy sand. The middle 7 inches is dark-brown, loose sand mottled with strong brown. The lower 15 inches is brown, firm clay loam mottled with yellowish brown. Between the middle and lower parts of the subsoil is a layer, 5 inches thick, of light brownish-gray, loose sand mottled with brownish yellow. The underlying material, beginning at a depth of about 42 inches, is grayish-brown clay loam mottled with yellowish brown.

Permeability is rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is moderate, and fertility is low. Surface runoff is slow.

Iosco soils are moderately suited to farming if excess water is removed and fertility is maintained. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few small areas remain in woodland or are used for pasture.

Representative profile of an Iosco loamy sand:

Ap—0 to 8 inches, dark-brown (7.5YR 3/2) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, wavy boundary.

B21ir—8 to 15 inches, dark yellowish-brown (10YR 4/4) loamy sand; weak, medium, subangular blocky structure; very friable; medium acid; gradual, wavy boundary.

B22ir—15 to 22 inches, dark-brown (7.5YR 4/4) sand; common, medium, distinct, strong-brown (7.5YR 5/8) mottles; single grain; loose; medium acid; clear, wavy boundary.

A'2—22 to 27 inches, light brownish-gray (10YR 6/2) sand; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; single grain; loose; slightly acid; abrupt, irregular boundary.

IIB'&A'—27 to 42 inches, brown (10YR 5/3) clay loam and light brownish-gray (10YR 6/2) sand interfingering; light brownish-gray material on surfaces of peds, and in and along worm and root channels; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

IIC—42 to 60 inches, grayish-brown (10YR 5/2) clay loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness and is strongly acid to neutral in the upper part and slightly acid to mildly alkaline in the lower part. The A1 horizon, where present, is very dark gray (10YR 3/1) and is 1 to 4 inches thick. The A'2 horizon, where present, is light gray (10YR 5/1 or 6/1) and is 2 to 5 inches thick. The Ap horizon is

dark brown (7.5YR 3/2 to 10YR 3/3) or very dark grayish brown (10YR 3/2) and is 6 to 10 inches thick. The B' part of the IIB'&A' horizon is yellowish brown (10YR 5/4 or 5/6), brown (10YR 5/3), or strong brown (7.5YR 5/6) and is clay loam, silty clay loam, or heavy loam. The IIB'&A' horizon is 5 to 20 inches thick. The IIC horizon is loam or clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Iosco soils formed in the same kind of material as Brevort and Menominee soils. These soils have browner colors in the B horizon than Brevort soils. They have mottles in the solum that are lacking in Menominee soils. Iosco soils are similar to Belding sandy loam and Iosco loamy sand, deep variant. They dominantly have a coarser texture in the upper part of the solum than Belding soils. Iosco soils have a thinner solum than Iosco soils, deep variant.

Iosco loamy sand, 0 to 2 percent slopes (IsA).—This soil is in depressions and flat areas. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are areas of the poorly drained Brevort soils in some small depressions. Also included are some small areas where the sandy material is underlain by clay loam at depths of 42 to 66 inches.

This soil is subject to soil blowing if the surface is exposed. Fertility is low. The main concern of management is removing excess water, but conserving moisture after drainage and control of soil blowing are also important.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is moderately suited to farming if excess water is removed and fertility is maintained. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIw-9 (4/2b); woodland suitability group G; recreation group 5.

Isoco stony loamy sand, 0 to 2 percent slopes (ItA).—This soil is on low beach ridges and in flat areas. The areas are small in size and irregular in shape. This soil has a profile similar to that described as representative of the series, except that stones, 10 to 20 inches in diameter and 5 to 30 feet apart, are on the surface and within the surface layer. Cobblestones, 3 to 6 inches in diameter, are in the upper part of the subsoil in many places.

Included with this soil in mapping are some small areas of poorly drained Brevort soils in small depressions. Also included are a few areas that are gently sloping.

The main concerns of management are removal of excess water and stones.

Most areas of this soil are used for pasture. A few areas are wooded. Stones are present in numbers that make tillage of cultivated crops impractical. This soil has severe limitations for most recreational and urban developments. Capability unit Vw-1 (4/2b); woodland suitability group G; recreation group 5.

Iosco Series, Deep Variant

The Iosco series, deep variant, consists of somewhat poorly drained, nearly level soils on till plains and low beach ridges. These soils formed in sandy and loamy glaciofluvial material. The native vegetation consisted mainly of aspen, oak, ash, and maple.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 9 inches thick. The first 5 inches of the subsoil is dark-brown, friable loamy sand. The second part, 10 inches thick, is strong-brown, very friable loamy sand mottled with light yellowish brown. The third part, 8 inches thick, is reddish-brown, firm coarse gravelly sandy clay loam mottled with yellowish brown. The fourth part, 4 inches thick, is brown, friable gravelly loam mottled with brownish yellow. Between the second and third parts of the subsoil is a layer, about 8 inches thick, of yellowish-brown, very friable loamy sand mottled with light yellowish brown. The underlying material, between depths of 44 and 50 inches, is light yellowish-brown gravelly sand. Below this, it is brown loam.

Permeability is rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is moderate, and fertility is low. Surface runoff is slow.

Iosco soils, deep variant, are moderately suited to farming if excess water is removed and moisture is conserved. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are wooded.

Representative profile of Iosco loamy sand, deep variant:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; clear, smooth boundary.

B21ir—9 to 14 inches, dark-brown (7.5YR 4/4) loamy sand; weak, fine, granular structure; friable; medium acid; clear, wavy boundary.

B22ir—14 to 24 inches, strong-brown (7.5YR 5/6) loamy sand; few, fine, faint, light yellowish-brown (10YR 6/4) mottles in lower part of the horizon; weak, fine, granular structure; very friable; strongly acid; clear, wavy boundary.

A'2—24 to 32 inches, yellowish-brown (10YR 5/4) loamy sand; few, fine, faint, light yellowish-brown (10YR 6/4) mottles; weak, thin, platy structure; very friable; neutral; clear, wavy boundary.

IIB'21t—32 to 40 inches, reddish-brown (5YR 4/4) coarse gravelly sandy clay loam; few, medium, distinct, yellowish-brown (10YR 5/4 and 5/6) mottles; weak, medium, subangular blocky structure; firm; clay films on surfaces of peds; 20 percent fine gravel; mildly alkaline; clear, wavy boundary.

IIB'22t—40 to 44 inches, brown (10YR 5/3) gravelly loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; massive; friable; clay films on surfaces of peds; 20 percent fine gravel; mildly alkaline; clear, wavy boundary.

IIIC1—44 to 50 inches, light yellowish-brown (10YR 6/4) gravelly sand; common, fine, faint, brownish-yellow (10YR 6/8) mottles; single grain; loose; 25 percent fine gravel; mildly alkaline; slight effervescence; abrupt, wavy boundary.

IVC2—50 to 66 inches, brown (10YR 5/3) loam; weak, coarse, blocky structure; firm; 10 percent gravel and cobblestones; mildly alkaline; slight effervescence.

The solum ranges from 40 to 60 inches in thickness. It is strongly acid to neutral in the sandy upper part and neutral or mildly alkaline in the loamy lower part. The Ap horizon is dark brown (10YR 3/3), very dark grayish brown (10YR 3/2), or very dark gray (10YR 3/1) and is 5 to 18 inches thick. The A'2 horizon is 8 to 18 inches thick. The IIIC1 horizon is sand or loamy sand or gravelly analogs of these textures. It is 1 inch to 8 inches thick. The IVC2 is

loam or clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Iosco soils, deep variant, are similar to Brevort, Iosco, Menominee, and Metamora soils. These soils have browner colors in the B horizon than Brevort soils. They have a thicker solum than Iosco soils. They have mottles in the solum that are lacking in Menominee soils. These soils have a coarser texture in the upper part of the solum than Metamora soils.

Iosco loamy sand, deep variant (0 to 2 percent slopes) (Iv).—This soil is on low beach ridges and in flat areas. The areas are small to medium in size and irregular in shape. Included with this soil in mapping are small, gently undulating areas where the slope is 2 to 6 percent.

This soil is subject to soil blowing if the surface is exposed. Fertility is low. The main concerns of management are removing excess water, controlling soil blowing, and conserving moisture.

Most areas of this soil are used for crops. A few areas remain wooded. This soil is moderately suited to farming if excess water is removed and moisture is conserved. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIw-9 (4/2b); woodland suitability group G; recreation group 5.

Kendallville Series

The Kendallville series consists of well-drained, gently sloping to rolling soils on till plains and moraines. These soils formed in loamy materials. The native vegetation consisted mainly of oak, maple, and hickory.

In a representative profile the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is yellowish-brown sandy loam about 4 inches thick. The upper part of the subsoil, 8 inches thick, is reddish-brown, firm sandy clay loam; the middle part, 13 inches thick, is dark reddish-brown, firm gravelly clay loam; and the lower part, 5 inches thick, is brown, firm clay loam. The underlying material, beginning at a depth of about 38 inches, is pale-brown heavy loam.

Permeability is moderate in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is high, and fertility is high.

Kendallville soils are well suited to hardwoods but poorly suited to pines. Areas of less sloping soils are well suited to farming. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are slight to moderate on the less sloping soils.

Most areas of these soils are used for crops. Some areas are used for permanent pasture or are wooded.

Representative profile of a Kendallville sandy loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; moderate, medium, granular structure; friable; less than 5 percent gravel; medium acid; abrupt, smooth boundary.

A2—8 to 12 inches, yellowish-brown (10YR 5/4) sandy loam; weak, coarse, granular structure; friable; less than 5 percent gravel; medium acid; clear, wavy boundary.

B21t—12 to 20 inches, reddish-brown (5YR 4/4) sandy clay loam; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; less than 5 percent gravel; slightly acid; clear, wavy boundary.

B22t—20 to 33 inches, dark reddish-brown (5YR 3/4) gravelly clay loam; moderate, coarse, subangular blocky structure; firm; clay films on surface of peds; 20 percent gravel; neutral; clear, wavy boundary.

IIB23t—33 to 38 inches, brown (10YR 5/3) clay loam; weak, coarse, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent gravel and cobblestones; neutral; abrupt, wavy boundary.

IIC—38 to 60 inches, pale-brown (10YR 6/3) heavy loam; massive; firm; 5 percent gravel and cobblestones; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is medium acid to mildly alkaline throughout. The A1 horizon, where present, is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2) and is 7 to 10 inches thick. The Bt horizon is dark yellowish brown (10YR 4/4), dark brown (7.5YR 4/4 or 10YR 4/3), reddish brown (5YR 4/4), dark reddish brown (5YR 3/4), or brown (10YR 5/3). It is clay loam or sandy clay loam or gravelly analogs of these textures. The IIC horizon is brown (10YR 5/3) or pale brown (10YR 6/3) and is clay loam or loam. It is mildly alkaline or moderately alkaline and has slight effervescence.

Kendallville soils formed in the same kind of material as Berville and Macomb soils. These soils lack mottles in the solum that are in the Berville and Macomb soils, and they have a lighter colored A horizon than those soils. Kendallville soils are similar to Fox, Miami, Newaygo, Owosso, and Tuscola soils. They have a finer texture in the C horizon than Newaygo and Fox soils. They have a higher content of coarse fragments in part of the B horizon than Miami and Owosso soils. Kendallville soils have coarse fragments in the profile that are lacking in Tuscola soils, and they lack the stratified material in the C horizon that is in the Tuscola soils.

Kendallville sandy loam, 2 to 6 percent slopes (KhB).—This soil is on knolls, ridges, and low mounds. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash. Also included are a few small eroded areas, at higher elevations, that are the source of the overwash materials. A few small wet areas are also included, especially in drainageways.

Surface runoff is slow, and the hazard of erosion is slight to moderate. The main concern of management is controlling erosion.

Most areas of this soil are used for crops. A few areas remain wooded. This soil is well suited to farming. It has slight to moderate limitations for recreational and urban developments. Capability unit IIe-2 (3/2a); woodland suitability group D; recreation group 2.

Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded (KhB2).—This soil is on knolls, ridges, and low mounds. The areas are small to medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer is thinner and is brown or yellowish brown.

Included with this soil in mapping are small areas, at higher elevations, that are severely eroded. These areas have lost all of their surface layer through erosion, and the sandy clay loam subsoil is exposed. Also included are small areas of Fox soils.

Surface runoff is slow to medium, and the hazard of erosion is moderate. The main concerns of management are controlling erosion and improving organic-matter content and tilth.

Most areas of this soil are used for crops. This soil is well suited to farming if erosion is controlled and

organic-matter content is improved. It has slight to moderate limitations for recreational and urban developments. Capability unit IIe-2 (3/2a); woodland suitability group D; recreation group 2.

Kendallville sandy loam, 6 to 12 percent slopes (KhC).—This soil is on knolls and ridges on uplands. The areas are small to medium in size and irregular in shape. Slopes are less than 100 feet long.

Included with this soil in mapping are small eroded areas. These eroded areas have a thin, brown surface layer. Also included are a few small wet areas in drainageways.

Surface runoff is medium, and the hazard of erosion is moderate to severe. The main concerns of management are controlling water erosion and conserving moisture.

Most areas of this soil are used for crops or permanent pasture. Some areas remain wooded. This soil is moderately suited to farming. It has moderate limitations for recreational and urban developments. Capability unit IIIe-5 (3/2a); woodland suitability group D; recreation group 2.

Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded (KhC2).—This soil is on knolls and ridges on uplands. The areas are small in size and irregular in shape. Slopes are less than 100 feet long. This soil has a profile similar to the one described as representative of the series, except that the surface layer is thinner and is brown or yellowish brown.

Included with this soil in mapping are small eroded areas where the sandy clay loam subsoil is exposed.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. The main concerns of management are controlling water erosion, improving organic-matter content and tilth, and conserving moisture.

Most areas of this soil are used for crops or permanent pasture. This soil is moderately suited to farming if erosion is controlled, if organic-matter content is increased, if tilth is improved, and if moisture is conserved. It has moderate limitations for most recreational and urban developments. Capability unit IIIe-5 (3/2a); woodland suitability group D; recreation group 2.

Kibbie Series

The Kibbie series consists of somewhat poorly drained, nearly level to gently undulating soils on lake plains and outwash plains. These soils formed in water-laid materials consisting of stratified silt loam and fine sand. The native vegetation consisted mainly of elm, beech, maple, and basswood.

In a representative profile the surface layer is very dark grayish-brown loam about 8 inches thick. The subsurface layer is pale-brown loam about 3 inches thick. The upper 5 inches of the subsoil is grayish-brown, friable heavy fine sandy loam mottled with yellowish brown; the lower 10 inches is grayish-brown, friable heavy loam mottled with yellowish brown. The underlying material, beginning at a depth of about 26 inches, is light-gray, stratified silt loam and fine sand.

Permeability is moderate, the available water capacity is high, and fertility is high. Surface runoff is slow.

Kibbie soils are well suited to farming if excess water is removed. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils generally are poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for woodland or pasture.

Representative profile of a Kibbie loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 11 inches, pale-brown (10YR 6/3) loam; weak, thin, platy structure; friable; neutral; clear, wavy boundary.

B21tg—11 to 16 inches, grayish-brown (10YR 5/2) heavy fine sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; clay films on surfaces of peds; neutral; clear, wavy boundary.

B22tg—16 to 26 inches, grayish-brown (10YR 5/2) heavy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; neutral; abrupt, wavy boundary.

IIC—26 to 60 inches, light-gray (10YR 7/2) stratified silt loam and fine sand; massive; very friable; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is slightly acid or neutral throughout. The A1 horizon, where present, is very dark gray (10YR 3/1) and is 1 to 4 inches thick. The Ap horizon is 7 to 10 inches thick. The Btg horizon is heavy fine sandy loam, heavy loam, or light silty clay loam. The IIC horizon contains thin strata of loam, sandy loam, or sand in a few places. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Kibbie soils formed in the same kind of material as Colwood and Tuscola soils. These soils have a thinner, dark-colored A horizon than Colwood soils and a darker colored Ap horizon than Tuscola soils. They are dominantly more grayish in the B horizon than Tuscola and Richter soils. Kibbie soils have a finer texture throughout the solum than Richter soils.

Kibbie loam, 0 to 2 percent slopes (KnA).—This soil is in flat areas on plains. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the poorly drained Colwood soils in small depressions. Also included are a few areas that have a clay loam or silty clay loam subsoil and substratum.

The hazard of erosion is slight. The main concern of management is removing excess water.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIw-6 (2.5b); woodland suitability group G; recreation group 3.

Kibbie loam, 2 to 6 percent slopes (KnB).—This soil is on undulating plains. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the poorly drained Colwood soils in small depressions. Also included are small areas where the subsoil and substratum are clay loam or silty clay loam.

The hazard of erosion is slight to moderate. The main concern of management is removing excess water, but controlling erosion is also a concern.

Most areas of this soil are used for crops. A few areas are wooded. This soil is well suited to farming if excess

water is removed. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIw-7 (2.5b); woodland suitability group G; recreation group 3.

Landes Series

The Landes series consists of well-drained, nearly level soils on flood plains of major streams in the county. These soils formed in sandy loam water-laid materials. In this county Landes soils are mapped in an undifferentiated unit with Eel and Abscota soils. The native vegetation consisted mainly of oak, maple, elm, and hickory.

In a representative profile the surface layer is dark grayish-brown sandy loam about 7 inches thick. The subsoil is brown, very friable sandy loam about 17 inches thick. The underlying material, beginning at a depth of about 24 inches, is yellowish-brown light sandy loam.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. Surface runoff is slow. These soils are seldom flooded after May.

Landes soils are well suited to openland wildlife habitat. Most areas are small in size and inaccessible because of meandering streams. Limitations for most nonfarm uses are moderate to severe. These soils are moderately suited to hardwoods and poorly suited to pines.

Most areas of these soils are used for woodland, pasture, wildlife habitat, or recreation. A few areas are used for crops.

Representative profile of Landes sandy loam, from an area of Eel, Landes, and Abscota soils:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; less than 5 percent gravel; neutral; abrupt, smooth boundary.

B2—7 to 24 inches, brown (7.5YR 5/4) sandy loam; very weak, fine, subangular blocky structure; very friable; neutral; gradual, wavy boundary.

C—24 to 60 inches, yellowish-brown (10YR 5/4) light sandy loam; massive; very friable; mildly alkaline.

The profile ranges from slightly acid to mildly alkaline throughout. The Ap horizon is dark gray (10YR 3/1) or dark grayish brown (10YR 4/2) and is 6 to 10 inches thick. The B horizon is yellowish brown (10YR 5/4, 5/6, or 5/8), dark yellowish brown (10YR 4/4), or brown (7.5YR 5/4) and is fine sandy loam or sandy loam. In a few places the C2 horizon contains strata of loamy fine sand, sand, or gravelly sand. It has slight effervescence in a few places.

The surface layer of these soils is lighter colored and thinner than is defined as the range for the series, but these differences do not alter the usefulness and behavior of these soils.

Landes soils formed in the same kind of material as Ceresco and Cohoctah soils. These soils lack the gray or grayish matrix colors and mottles in the upper part of the subhorizons that are in the Ceresco soils. They lack the gray or grayish matrix colors in the subhorizons that are typical of Cohoctah soils. Landes soils are in an undifferentiated unit with Abscota and Eel soils. These soils dominantly have a finer texture in the subhorizons than Abscota soils. They dominantly have a coarser texture in the subhorizons than Eel soils.

Lapeer Series

The Lapeer series consists of well-drained, gently sloping or sloping soils on till plains and moraines. These soils formed in sandy loam glacial till. The native vegetation consisted mainly of oak, maple, and hickory.

In a representative profile the surface layer is dark grayish-brown sandy loam about 7 inches thick. The subsurface layer is pale-brown sandy loam about 4 inches thick. The upper 6 inches of the subsoil is yellowish-brown, friable heavy sandy loam. The middle 7 inches is strong-brown, firm sandy clay loam. The lower 12 inches is yellowish-brown, firm light sandy clay loam. The underlying material, beginning at a depth of about 36 inches, is brown sandy loam.

Permeability is moderate, the available water capacity is moderate, and fertility is medium.

Lapeer soils are well suited to farming. They are well suited to openland wildlife habitat. Limitations for nonfarm uses are slight on the less sloping soils. These soils are well suited to woodland.

Most areas of these soils are used for crops.

Representative profile of a Lapeer sandy loam:

Ap—0 to 7 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; 5 percent coarse fragments; medium acid; abrupt, smooth boundary.

A2—7 to 11 inches, pale-brown (10YR 6/3) sandy loam; weak, coarse, granular structure; friable; 5 percent coarse fragments; medium acid; clear, wavy boundary.

B1—11 to 17 inches, yellowish-brown (10YR 5/4) heavy sandy loam; weak, fine, subangular blocky structure; friable; 5 percent coarse fragments; slightly acid; gradual, wavy boundary.

B21t—17 to 24 inches, strong-brown (7.5YR 5/6) sandy clay loam; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; mildly alkaline; gradual, wavy boundary.

B22t—24 to 36 inches, yellowish-brown (10YR 5/8) light sandy clay loam; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; mildly alkaline; abrupt, wavy boundary.

C—36 to 60 inches, brown (10YR 5/3) sandy loam; massive; friable; 10 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 24 to 36 inches in thickness and is medium acid to mildly alkaline throughout. The A1 horizon, if present, is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The Ap horizon is 6 to 10 inches thick. The A2 horizon, if present, is brown (10YR 5/3) or pale brown (10YR 6/3). The Bt horizon is sandy clay loam or light clay loam. The B21t horizon is yellowish brown (10YR 5/4, 5/6, or 5/8) or strong brown (7.5YR 5/6). The C horizon is light yellowish brown (10YR 6/4) or brown (10YR 5/3). It is mildly alkaline or moderately alkaline and has slight effervescence.

Lapeer soils formed in the same kind of material as Barry and Locke soils. These soils lack the mottles in the B horizon that are in the Barry and Locke soils, and they have a lighter colored Ap horizon than those soils. Lapeer soils are similar to Boyer and Miami soils. These soils are finer textured in the C horizon and average fewer coarse fragments in the C horizon than Boyer soils. They have more sand separates throughout than Miami soils, and they average a lower content of clay in the Bt horizon than those soils.

Lapeer sandy loam, 2 to 6 percent slopes (LmB).—This soil is on knolls, ridges, and low mounds. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small depressional areas that are covered by a layer of loamy soil. Also included are a few small eroded areas, at higher

elevations, that are the source of the overwash materials. They have a yellowish-brown surface layer.

Surface runoff is slow, and the hazard of erosion is slight to moderate. The main concern of management is controlling erosion.

Most areas of this soil are used for crops. This soil is well suited to farming. It has slight limitations for most recreational and urban developments. Capability unit IIe-3 (3a); woodland suitability group U; recreation group 2.

Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded (LmC2).—This soil is near drainageways or depressions. The areas are small in size and irregular in shape. Slopes are less than 100 feet long. This soil has a profile similar to the one described as representative of the series, except that the surface layer is thin and is yellowish brown.

Included with this soil in mapping are small areas of poorly drained Barry soils in depressions and narrow drainageways. Also included are small, severely eroded areas on side slopes where the brown sandy clay loam part of the subsoil is exposed.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. The main concern of management is controlling water erosion.

Most areas of this soil are used for crops. This soil is moderately suited to farming if erosion is controlled. It has moderate limitations for most recreational and urban developments. Capability unit IIIe-6 (3a); woodland suitability group U; recreation group 2.

Lenawee Series

The Lenawee series consists of poorly drained, nearly level soils on lake plains. These soils formed in waterlaid materials that consist mainly of silty clay loam or clay loam with thin strata of silt loam, sandy loam, and clay. The native vegetation consisted mainly of elm, ash, red maple, and swamp white oak.

In a representative profile the surface layer is very dark gray silt loam about 9 inches thick. The upper 5 inches of the subsoil is gray, friable heavy silt loam; the lower 11 inches is gray, firm heavy silty clay loam mottled with dark yellowish brown. The underlying material, beginning at a depth of about 25 inches, is gray, stratified silty clay loam and clay loam with thin strata of silt loam, sandy loam, and clay. It has mottles of yellowish brown.

Permeability is moderately slow, the available water capacity is high, and fertility is high. Surface runoff is very slow or ponded.

Lenawee soils are well suited to farming if excess water is removed and tilth is maintained. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for crops. A few areas remain in woodland.

Representative profile of Lenawee silt loam:

Ap—0 to 9 inches, very dark gray (10YR 3/1) silt loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

B21g—9 to 14 inches, gray (10YR 5/1) heavy silt loam; moderate, fine, subangular blocky structure; friable; very dark grayish-brown (10YR 3/2) films on surfaces of peds; neutral; clear, wavy boundary.

B22g—14 to 25 inches, gray (N 5/0) heavy silty clay loam; common thin strata of silt loam and clay; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; moderate, medium, angular blocky structure; firm; mildly alkaline; abrupt, wavy boundary.

Cg—25 to 60 inches, gray (N 6/0) stratified silty clay loam and clay loam; common thin strata of silt loam, sandy loam, and clay; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm; mildly alkaline; slight effervescence.

The solum ranges from 25 to 42 inches in thickness and is slightly acid to mildly alkaline throughout. The Ap horizon is very dark brown (10YR 2/2) or very dark gray (10YR 3/1) and is 8 to 10 inches thick. The Bg horizon is grayish brown (10YR 5/2), gray (10YR 5/1 or N 5/0), or light brownish gray (10YR 6/2). The B21g horizon is heavy silt loam or silty clay loam. The B22g horizon is heavy silty clay loam or light silty clay. The Bg horizon contains strata, 1 to 4 inches thick, of sandy loam, light silt loam, or clay in a few places. The Cg horizon is grayish brown (10YR or 2.5Y 5/2) or gray (10YR 5/1 or 6/1, N 5/0 or N 6/0). The Cg horizon is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Lenawee soils are similar to Brookston and Colwood soils. These soils have stratified material in the C horizon that is lacking in Brookston soils, and they lack the coarse fragments in the profile that are in the Brookston soils. They dominantly have a finer texture throughout the profile than Colwood soils.

Lenawee silt loam (0 to 2 percent slopes) (Ln).—This soil is in depressions and flat areas. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small, slightly higher areas of somewhat poorly drained Kibbie soils. Also included are small areas of poorly drained Colwood soils.

This soil is ponded in some areas early in spring and after heavy rains. Permeability is moderately slow. The main concern of management is removal of excess water, but poor soil tilth is a concern in many areas.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if excess water is removed and tilth is maintained. It has severe limitations for recreational and urban developments. Capability unit IIw-4 (1.5c); woodland suitability group P; recreation group 4.

Linwood Series

The Linwood series consists of very poorly drained, nearly level soil in depressions on till plains, lake plains, and moraines. These soils formed in organic materials, 12 to 42 inches thick, over loamy material (fig. 7). The native vegetation consisted mainly of alder, willow, ash, and soft maple.

In a representative profile the upper 32 inches is black muck. Many wood fragments are below a depth of 10 inches. The underlying material, beginning at a depth of about 32 inches, is grayish-brown light clay loam.

Permeability is moderately rapid in the organic material and moderate in the loamy material. The available water capacity is very high in the organic material and moderate in the loamy material. Fertility is low, especially in micronutrients. Surface runoff is very slow or ponded.

Figure 7.—**Profile of Linwood muck. Loamy material lies below the muck. The numbers refer to depth in feet.**

Linwood soils are well suited to farming if excess water is removed, if adequately fertilized, and if soil blowing is controlled. They are well suited to wetland wildlife. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for crops. Truck crops and potatoes are the main crops. Some areas remain in swamp vegetation and woods.

Representative profile of Linwood muck:

1—0 to 10 inches, black (10YR 2/1) muck; moderate, fine, granular structure; friable; slightly acid.

2—10 to 32 inches, black (5YR 2/1) muck; weak, coarse, granular structure; friable; many wood fragments; slightly acid.

IIC—32 to 60 inches, grayish-brown (10YR 5/2) light clay loam; massive; firm; mildly alkaline; slight effervescence.

The organic material ranges from 12 to 42 inches in thickness over loamy material. The organic material is medium acid to mildly alkaline throughout. Woody fragments in the organic material range from few to many. The 2 horizon is black (10YR 2/1 or 5YR 2/1), very dark brown (10YR 2/2), or dark reddish brown (5YR 2/2). The IIC horizon is loam, light silty clay loam, or light clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence to strong effervescence.

Linwood soils are similar to Carlisle, Edwards, Tawas, and Wallkill soils. These soils lack organic material, 42 inches or more thick, that is typical of Carlisle soils. They lack the marl at a depth of 12 to 42 inches that is in the Edwards soils. These soils have loamy material at a depth of 12 to 42 inches instead of sandy material that is in the Tawas soils. They lack 10 to 40 inches of loamy material immediately above the organic material that is in the Wallkill soils.

Linwood muck (0 to 2 percent slopes) (Lo).—This soil is in depressions and swales on uplands and in swampy flats on lowlands. The areas are small in size and irregular in shape.

Included with this soil in mapping are small, burned-over areas. These burned-over areas have only a few inches of muck remaining, and the surface layer is alkaline in a few places. Also included are a few small areas of poorly drained Colwood soils at slightly higher elevations and a few small areas where the underlying material is clay.

This soil is very susceptible to soil blowing if the surface is exposed. The main concerns of management are removing excess water, control of soil blowing, improving and maintaining fertility, and preventing frost damage.

Most areas of this soil are used for crops. Some areas remain in swamp vegetation or woods. This soil is well suited to farming if excess water is removed, if it is adequately fertilized, and if soil blowing is controlled. It has very severe limitations for recreational and urban developments. Capability unit IIw-10 (M/3c); woodland suitability group J; recreation group 7.

Locke Series

The Locke series consists of somewhat poorly drained, nearly level or gently sloping soils on till plains and low moraines. These soils formed in sandy loam glacial till. The native vegetation consisted mainly of oak, ash, basswood, and hickory.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 7 inches thick. The subsurface layer is pale-brown sandy loam about 5 inches thick. The upper 4 inches of the subsoil is grayish-brown, firm heavy sandy loam mottled with yellowish brown; the lower 14 inches is grayish-brown, firm sandy clay loam mottled with brownish yellow. The underlying material, beginning at a depth of 30 inches, is brown sandy loam mottled with brownish yellow.

Permeability is moderate, the available water capacity is moderate, and fertility is medium. Surface runoff is slow.

Locke soils are well suited to farming if excess water is removed. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas remain in woodland.

Representative profile of a Locke sandy loam:

Ap—0 to 7 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; 5 percent coarse fragments; slightly acid; abrupt, wavy boundary.

A2—7 to 12 inches, pale-brown (10YR 6/3) sandy loam; weak, coarse, granular structure; friable; 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B21tg—12 to 16 inches, grayish-brown (10YR 5/2) heavy sandy loam; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B22tg—16 to 30 inches, grayish-brown (10YR 5/2) sandy clay loam; common, medium, distinct, brownish-yellow (10YR 6/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 10 percent coarse fragments; slightly acid; abrupt, wavy boundary.

C—30 to 60 inches, brown (10YR 5/3) sandy loam; many, medium, distinct, brownish-yellow (10YR 6/8) mottles; massive; friable; 10 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 22 to 40 inches in thickness and is medium acid or slightly acid throughout. The A1 horizon, if present, is very dark gray (10YR 3/1) and is 2 to 4 inches thick. The A2 horizon is brown (10YR 5/3) or pale brown (10YR 6/3). The Btg horizon is heavy loam, heavy sandy loam, sandy clay loam, or light clay loam. The C horizon contains thin strata of loamy sand or sand in a few places. It is mildly alkaline or moderately alkaline and has slight effervescence to strong effervescence.

The Btg horizon averages a higher content of clay than is defined as the range for the series, and this difference alters the usefulness and behavior of these soils for some farm and nonfarm uses.

Locke soils formed in the same kind of material as Barry and Lapeer soils. These soils have a thinner, dark-colored A horizon than Barry soils. They have mottles in the B horizon that are lacking in Lapeer soils, and they have a darker colored Ap horizon than those soils. Locke soils are similar to Barry soils, bedrock variant, and Richter and Wasepi soils. They lack bedrock at a depth of less than 40 inches that is in the Barry soils, bedrock variant. They have a more grayish matrix color in the upper part of the B horizon than Richter soils, and they have coarse fragments throughout that are lacking in those soils. They have a finer texture in the C horizon and, on the average, have a lower content of coarse fragments in the C horizon than Wasepi soils.

Locke sandy loam, 0 to 2 percent slopes (LsA).—This soil is on flats on uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of poorly drained Barry soils in small depressions and narrow drainageways. Also included are small depressional areas that are covered by a thin layer of loamy overwash. Other inclusions are a few small areas where surface stones are numerous enough to make cultivation impractical.

The hazard of erosion is slight. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIw-6 (3b); woodland suitability group G; recreation group 3.

Locke sandy loam, 2 to 6 percent slopes (LsB).—This soil is on knolls and ridges. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash. Also included are a few small eroded areas at higher elevations; these areas are the source of the overwash material. The eroded areas have a grayish-brown surface layer.

The hazard of erosion is slight. The main concern of management is removing excess water, but controlling erosion is also a concern.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIw-7 (3b); woodland suitability group G; recreation group 3.

Macomb Series

The Macomb series consists of somewhat poorly drained, nearly level or gently sloping soils on till plains and low moraines. These soils formed in loamy materials. The native vegetation consisted mainly of elm, ash, oak, and maple.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 4 inches thick, is grayish-brown sandy loam mottled with yellowish brown. The upper 4 inches of the subsoil is grayish-brown, friable loam mottled with strong brown. The middle 10 inches is brown, firm gravelly sandy clay loam mottled with gray and yellowish brown. The lower 7 inches is light brownish-gray, firm clay loam mottled with yellowish brown. The underlying material, beginning at a depth of about 33 inches, is brown heavy loam mottled with yellowish brown.

Permeability is moderately slow, the available water capacity is high, and fertility is high. Surface runoff is slow.

Macomb soils are well suited to farming if excess water is removed. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops.

Representative profile of a Macomb sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; less than 5 percent coarse fragments; neutral; abrupt, smooth boundary.

A2—8 to 12 inches, grayish-brown (10YR 5/2) sandy loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, granular structure; friable; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B21g—12 to 16 inches, grayish-brown (10YR 5/2) loam; common, medium, distinct, strong-brown (7.5YR 5/6) mottles; moderate, fine, subangular blocky structure; friable; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B22t—16 to 26 inches, brown (7.5YR 5/4) gravelly sandy clay loam; many, medium, distinct, gray (10YR 5/1) and yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 20 percent coarse fragments; slightly acid; abrupt, wavy boundary.

IIB23tg—26 to 33 inches, light brownish-gray (10YR 6/2) clay loam; many, medium, distinct, yellowish-brown

(10YR 5/4) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

IIC—33 to 60 inches, brown (10YR 5/3) heavy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, subangular blocky structure; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is medium acid to neutral throughout. The A1 horizon, where present, is very dark gray (10YR 3/1) and is 2 to 4 inches thick. The Ap horizon is 7 to 10 inches thick. The A2 horizon is brown (10YR 5/3) or grayish brown (10YR 5/2). The B21g horizon is gravelly clay loam, gravelly sandy clay loam, or loam. The B22t horizon is clay loam or sandy clay loam or gravelly analogs of these textures. The IIC horizon is clay loam or loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Macomb soils formed in the same kind of material as Berville and Kendallville soils. These soils have a thinner, lighter colored A horizon than Berville soils. They have mottles in the solum that are lacking in Kendallville soils, and they have a darker colored A horizon than those soils. Macomb soils are similar to Conover, Matherton, Metamora, and Wasepi soils. These soils have gravelly soil material in all or part of the B horizon that is lacking in Conover soils. They have a finer texture in the C horizon and average a lower content of coarse fragments in the C horizon than Matherton and Wasepi soils. They average a higher content of clay in the Bt horizon than Wasepi soils. These soils have more coarse fragments in all or part of the B horizon than Metamora soils.

Macomb loam, 0 to 2 percent slopes (MoA).—This soil is on flats on uplands. The areas are small to medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer is loam.

Included with this soil in mapping are small areas of the poorly drained Berville soils. Also included are a few small areas where stones on the surface and in the subsoil are numerous enough to make cultivation impractical.

The main concern of management is removal of excess water.

Most areas of this soil are used for crops. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIw-4 (3/2b); woodland suitability group Z; recreation group 3.

Macomb sandy loam, 2 to 6 percent slopes (MbB).—This soil is on knolls, ridges, and low mounds on uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the poorly drained Berville soils in small depressions and narrow drainageways, as well as small areas of the somewhat poorly drained Matherton soils. Also included are a few areas where the surface layer is loam.

The hazard of erosion is slight to moderate. The main concern of management is removing excess water, but controlling erosion is also a concern.

Most areas of this soil are used for crops. A few areas are used for pasture or woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIw-5 (3/2b); woodland suitability group Z; recreation group 3.

Made Land

Made land (Md) consists of areas that have been covered by fill material or that have been removed by grading. As a result, the original soil features have been destroyed.

This land type is used for housing developments, industrial sites, old city dumps, and refuse disposal areas throughout the county. Capability unit VIIIs-1 (Sa); not placed in a woodland suitability group or recreation group.

Mancelona Series

The Mancelona series consists of well-drained, nearly level to gently sloping soils on outwash plains, till plains, and stream terraces. These soils formed in loamy sand and sandy loam materials, 18 to 40 inches thick, over gravelly coarse sand. The native vegetation consisted mainly of oak, maple, and some red pine and white pine.

In a representative profile the surface layer is very dark brown loamy sand about 7 inches thick. The upper 4 inches of the subsoil is dark-brown, very friable loamy sand; the middle 9 inches is yellowish-brown, loose loamy sand; the lower 8 inches is dark-brown, friable sandy loam. The underlying material, beginning at a depth of about 28 inches, it very pale brown gravelly coarse sand.

Permeability is moderately rapid, the available water capacity is low, and fertility is low. Surface runoff is slow.

Mancelona soils are moderately well suited to farming. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are slight. These soils are well suited to pines and moderately well suited to hardwoods.

Most areas of these soils are used for crops. A few areas are wooded.

Representative profile of a Mancelona loamy sand:

Ap—0 to 7 inches, very dark brown (10YR 2/2) loamy sand; weak, fine, granular structure; very friable; 5 percent gravel; neutral; abrupt, smooth boundary.

B21ir—7 to 11 inches, dark-brown (7.5YR 4/4) loamy sand; weak, fine, subangular blocky structure; very friable; 5 percent gravel; medium acid; abrupt, wavy boundary.

B22ir—11 to 20 inches, yellowish-brown (10YR 5/6) loamy sand; single grain; loose; 5 percent gravel; slightly acid; clear, wavy boundary.

Bt—20 to 28 inches, dark-brown (7.5YR 4/4) sandy loam; weak, medium, subangular blocky structure; friable; clay bridges connect sand grains; 20 percent gravel; neutral; abrupt, irregular boundary.

IIC—28 to 60 inches, very pale brown (10YR 8/3) gravelly coarse sand; single grain; loose; 30 percent gravel; mildly alkaline; slight effervescence.

The solum ranges from 22 to 40 inches in thickness and is medium acid to mildly alkaline throughout. The Ap horizon is very dark grayish brown (10YR 3/2) or very dark brown (10YR 2/2) and is 6 to 10 inches thick. The Bt horizon is gravelly light sandy loam or sandy loam. The IIC horizon is brown (10YR 5/3), pale brown (10YR 6/3), or very pale brown (10YR 8/3). It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Mancelona soils formed in the same kind of material as Gladwin soils. These soils lack mottles in the solum that are in the Gladwin soils. Mancelona soils have drainage similar to that of Menominee and Newaygo soils, Plainfield soils, slightly acid variant, and Spinks soils. They have a coarser texture in the C horizon and, average a higher content of coarse fragments in the C horizon than Menominee soils. These soils have a coarser texture in the solum than Newaygo soils in horizons that have similar horizon designations. They have a loamy Bt horizon that is lacking in Plainfield soils, slightly acid variant. They lack the bands designated as Bt horizon and that are in the Spinks soils, and average a higher content of clay in the Bt horizon than those soils. Mancelona soils have a considerable amount of coarse fragments in the C horizon, which are lacking in Plainfield soils, slightly acid variant, and Spinks soils.

Mancelona loamy sand, 0 to 2 percent slopes (MeA).—This soil is on flats. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the poorly drained Gilford soils in depressions. Also included are small areas where cobblestones and gravel are on the surface but do not interfere with tillage.

This soil is very susceptible to soil blowing if the surface is exposed. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture and control of soil blowing, but improving and maintaining fertility and organic-matter content are also important.

Most areas of this soil are used for crops. This soil is moderately suited to farming if moisture is conserved and fertility improved. It has slight limitations for recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group C; recreation group 1.

Mancelona loamy sand, 2 to 6 percent slopes (MeB).—This soil is on knolls and ridges on plains. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of Gilford soils in depressions and narrow drainageways. Also included are some small areas where cobblestones and gravel are scattered on the surface but do not interfere with tillage. Also included are a few small eroded areas that have a dark-brown surface layer.

This soil is very susceptible to soil blowing if the surface is exposed. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture and control of soil blowing, but improving and maintaining fertility and organic-matter content are also important.

Most areas of this soil are used for crops. This soil is moderately suited to farming if moisture is conserved and fertility and organic-matter content are improved. It has slight limitations for most recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group C; recreation group 1.

Matherton Series

The Matherton series consists of somewhat poorly drained, nearly level to gently sloping soils on outwash plains and valley trains. These soils formed in loamy materials, 24 to 40 inches thick, over gravelly sand. Matherton soils, loamy substratum, are underlain by loamy material at depths ranging from 42 to 66 inches. The native vegetation consisted mainly of pin oak, red maple, white oak, and hickory.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is grayish-brown sandy loam about 3 inches thick. The upper 8 inches of the subsoil is brown, firm sandy clay loam mottled with olive brown; and the lower 16 inches is grayish-brown, firm gravelly clay loam mottled with strong brown. The underlying material, beginning at a depth of about 35 inches, is light-gray, very gravelly coarse sand.

Permeability is moderate in the subsoil and very rapid in the underlying material. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

Matherton soils are well suited to farming if excess water is removed. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas remain in woodland.

Representative profile of a Matherton sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2—8 to 11 inches, grayish-brown (10YR 5/2) sandy loam; few, fine, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, granular structure; friable; less than 5 percent gravel; slightly acid; clear, wavy boundary.

B21t—11 to 19 inches, brown (10YR 5/3) sandy clay loam; common, medium, distinct, olive-brown (2.5Y 4/4) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 10 percent gravel; slightly acid; clear, wavy boundary.

B22tg—19 to 35 inches, grayish-brown (10YR 5/2) gravelly clay loam; many, medium, distinct, strong-brown (7.5YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 20 percent gravel; neutral; abrupt, irregular boundary.

IICg—35 to 60 inches, light-gray (10YR 7/1) very gravelly coarse sand; single grain; loose; 35 percent gravel; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is medium acid or neutral throughout. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 7 to 10 inches thick. The A2 horizon is brown (10YR 5/3) or grayish brown (10YR 5/2). The B21t horizon is sandy clay loam or clay loam and gravelly analogs of these textures. The B22tg horizon is clay loam or gravelly clay loam. The IICg horizon is grayish brown (10YR 5/2), light gray (10YR 7/1), or light brownish gray (10YR 6/2). It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Matherton soils formed in the same kind of material as Fox and Sebewa soils. These soils have mottles in the solum that are lacking in Fox soils, and they have a thicker or darker colored A horizon than those soils. They have a thinner, dark-colored A horizon than Sebewa soils. Matherton soils are similar to Macomb, Metamora, and Wasepi soils. They have a coarser texture in the C horizon and average a higher content of coarse fragments in the C horizon than Macomb and Metamora soils. These soils have a considerably higher content of coarse fragments in all or part of the B horizon than Metamora soils. They average more clay in the Bt horizon than Wasepi soils.

Matherton sandy loam, 0 to 2 percent slopes (MmA).—This soil is in flat areas on plains. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the poorly drained Sebewa soils in depressions and narrow drainageways and small areas of Macomb soils. Also included are a few small depressional areas that are covered by a thin layer of loamy overwash.

The hazard of soil blowing is slight. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-6 (3b); woodland suitability group G; recreation group 3.

Matherton sandy loam, 2 to 6 percent slopes (MmB).—This soil is on knolls and ridges on plains. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash. Also included are a few small eroded areas, at higher elevations, that are the source of the overwash material. Also included are a few small areas of the loamy substratum phase of Matherton soils.

The hazard of erosion is slight to moderate. The main concern of management is removing excess water, but controlling water erosion and conserving moisture are also concerns.

Most areas of this soil are used for crops. Small areas remain in woodland. This soil is well suited to farming if excess water is removed and erosion is controlled. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-7 (3b); woodland suitability group G; recreation group 3.

Matherton sandy loam, loamy substratum, 0 to 2 percent slopes (MnA).—This soil is in flat areas on plains. The areas are small to medium in size and irregular in shape. This soil has a profile similar to that described as representative of the series, except that it is underlain by loamy materials at depths ranging from 42 to 66 inches.

Included with this soil in mapping are small areas of the poorly drained Sebewa soils in small depressions and narrow drainageways. Also included are small areas that are covered by sandy overwash material from nearby soils at higher elevations.

The hazard of erosion is slight. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. Some areas are wooded. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2b); woodland suitability group G; recreation group 3.

Matherton sandy loam, loamy substratum, 2 to 6 percent slopes (MnB).—This soil is on knolls and ridges. The areas are small to medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that it is underlain by loamy materials at depths of 42 to 66 inches.

Included with this soil in mapping are small areas of eroded soils at higher elevations. Also included are small depressional areas that are covered by a thin layer of sandy overwash material.

The hazard of erosion is slight to moderate. The main concern of management is removing excess water, but controlling erosion and conserving moisture are also concerns.

Most areas of this soil are used for crops. Some areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2b); woodland suitability group G; recreation group 3.

Menominee Series

The Menominee series consists of well-drained, gently sloping or rolling soils on till plains, outwash plains, moraines, and beach ridges. These soils formed in loamy sand, 18 to 42 inches thick, over light clay loam glacial till. The native vegetation consisted mainly of oak, maple, hickory, basswood, and ash.

In a representative profile the surface layer is very dark grayish-brown loamy sand about 10 inches thick. The upper 9 inches of the subsoil is yellowish-brown, very friable loamy sand; the middle 5 inches is strong-brown, loose loamy sand; and the lower 4 inches is dark-brown, firm gravelly sandy clay loam. The underlying material, beginning at a depth of about 28 inches, is dark grayish-brown light clay loam.

Permeability is rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is moderate, and fertility is low.

Menominee soils are generally moderately suited to farming. They are well suited to openland wildlife habitat. Limitations for nonfarm uses are moderate to severe on the less sloping soils. These soils are well suited to woodland.

Most areas of gently sloping Menoninee soils are used for crops. The more sloping areas are mostly wooded or used for pasture. A few of these areas are used for crops.

Representative profile of a Menominee loamy sand:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy sand; weak, fine, granular structure; very friable; medium acid; abrupt, smooth boundary.

B21ir—10 to 19 inches, yellowish-brown (10YR 5/4) loamy sand; weak, fine, subangular blocky structure; very friable; slightly acid; clear, wavy boundary.

B22ir—19 to 24 inches, strong-brown (7.5YR 5/6) loamy sand; single grain; loose; slightly acid; abrupt, wavy boundary.

Bt—24 to 28 inches, dark-brown (10YR 4/3) gravelly sandy clay loam; weak, coarse, subangular blocky structure; firm; clay films on surfaces of peds; 20 percent gravel; mildly alkaline; abrupt, wavy boundary.

IIC—28 to 60 inches, dark grayish-brown (10YR 4/2) light clay loam; massive; firm; 10 percent gravel and cobblestones; mildly alkaline; slight effervescence.

The solum ranges from 22 to 40 inches in thickness. The sandy material is medium acid or slightly acid throughout. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 7 to 10 inches thick. The Bir horizon is sand or loamy sand. The Bt horizon is sandy loam, gravelly loam, gravelly sandy clay, loam, or clay loam

and is neutral or mildly alkaline. It is 3 to 10 inches thick. The IIC horizon is loam, light clay loam, or light silty clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Menominee soils formed in the same kind of material as Brevort and Iosco soils. These soils lack mottles in the solum that are in the Brevort and Iosco soils. Menominee soils are similar to Mancelona and Owosso soils. They have a finer texture in the C horizon and average a lower content of coarse fragments in the C horizon than Mancelona soils. These soils have a coarser texture in the upper part of the solum than Owosso soils.

Menominee loamy sand, 2 to 6 percent slopes (MoB).—This soil is on knolls and ridges on plains and uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are a few small, wet depressional areas that are covered by a thin layer of sandy overwash material. Also included are small eroded areas where the surface layer is thinner and browner than in this soil. A few areas are included where the underlying light clay loam is at a depth of 42 to 66 inches.

Surface runoff is slow. This soil is very susceptible to soil blowing if the surface is exposed. Fertility is low. The main concerns of management are conserving moisture and controlling erosion, but improving and maintaining fertility and organic-matter content are also important.

Most areas of this soil are used for crops. A few areas are used for permanent pasture or are wooded. This soil is moderately suited to farming if moisture is conserved and fertility is maintained. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIs-4 (4/2a); woodland suitability group C; recreation group 1.

Menominee loamy sand, 6 to 12 percent slopes (MoC).—This soil is on knolls and ridges on uplands. The areas are small in size and irregular in shape. Slopes are less than 100 feet long.

Included with this soil in mapping are small eroded areas on side slopes. These eroded areas have a brown surface layer that is thinner than that of the profile described as representative of the series. Also included are a few areas where the underlying light clay loam is at a depth of 42 to 66 inches.

Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. This soil is susceptible to soil blowing if the surface is exposed. Fertility is low. The main concerns of management are controlling erosion and conserving moisture, but improving and maintaining fertility and organic-matter content are also important.

Most areas of this soil are in permanent vegetation. Some areas are used for crops. This soil is moderately suited to farming if erosion is controlled, moisture is conserved, and fertility is improved. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIe-9 (4/2a); woodland suitability group C; recreation group 1.

Metamora Series

The Metamora series consists of somewhat poorly drained, nearly level to gently sloping soils on till plains and low moraines. These soils formed in sandy loam, 18 to 40 inches thick, and in the underlying loamy glacial till. The native vegetation consisted mainly of ash, oak, hickory, basswood, and maple.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 9 inches thick. The subsurface layer, about 4 inches thick, is light brownish-gray sandy loam mottled with yellowish brown. The upper 15 inches of the subsoil is grayish-brown, friable sandy loam mottled with brownish yellow; the lower 8 inches is grayish-brown, firm clay loam mottled with yellowish brown. The underlying material, beginning at a depth of about 36 inches, is grayish-brown heavy loam mottled with yellowish brown.

Permeability is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. The available water capacity is high, and fertility is medium. Surface runoff is slow.

Metamora soils are well suited to moderately well suited to farming if excess water is removed. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for permanent pasture or woodland.

Representative profile of a Metamora sandy loam:

Ap—0 to 9 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, fine, granular structure; friable; slightly acid; abrupt, smooth boundary.

A2g—9 to 13 inches, light brownish-gray (10YR 6/2) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, granular structure; friable; less than 5 percent coarse fragments; slightly acid; clear, wavy boundary.

B1g—13 to 28 inches, grayish-brown (10YR 5/2) sandy loam; many, medium, distinct, brownish-yellow (10YR 6/8) mottles; weak, medium, subangular blocky structure; friable; less than 5 percent coarse fragments; neutral; clear, wavy boundary.

IIB2tg—28 to 36 inches, grayish-brown (10YR 5/2) clay loam; many, medium, distinct, yellowish-brown (10YR 5/8) mottles; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

IICg—36 to 60 inches, grayish-brown (10YR 5/2) heavy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; massive; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness and is slightly acid to mildly alkaline throughout. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 8 to 10 inches thick. The B1g horizon is brown (10YR 5/3) or grayish brown (10YR 5/2) and is sandy loam or loamy sand. The IIB2tg horizon is sandy clay loam or clay loam. The IICg horizon is brown (10YR 5/2) or grayish brown (10YR 5/2) and is heavy loam or clay loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The solum of these soils has a more grayish color in the upper part than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Metamora soils formed in the same kind of material as Owosso soils. These soils have mottles in the solum that are lacking in Owosso soils, and they are thicker or darker

colored in the Ap or A1 horizon than those soils. Metamora soils are similar to Conover soils, Iosco soils, deep variant, Macomb, and Matherton soils. They have a coarser texture in the subhorizons in the upper part of the solum than Conover soils. They have a finer texture in the upper part of the solum than Iosco soils, deep variant. They average fewer coarse fragments in the B horizon than Macomb soils. They have a finer texture in the C horizon and average a lower content of coarse fragments in the C horizon than Matherton soils; they have a considerably lower content of coarse fragments in the B horizon than those soils.

Metamora loamy sand, 0 to 2 percent slopes (MrA).—This soil is in flat areas on uplands. The areas are small to large in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer and the upper part of the subsoil are loamy sand to a depth of 20 inches.

Included with this soil in mapping are areas of the poorly drained Breckenridge soils in small depressions and narrow drainageways. In addition, a few areas are included where the heavy loam underlying material is at depths between 42 and 66 inches. Other inclusions are areas where the slope is 2 to 6 percent.

The main concern of management is removing excess water, but conserving moisture and control of soil blowing are also concerns.

Most areas of this soil are used for crops. A few areas remain wooded. This soil is moderately well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2b); woodland suitability group G; recreation group 3.

Metamora sandy loam, 0 to 2 percent slopes (MsA).—This soil is on flats on uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of the poorly drained Breckenridge soils in small depressions and narrow drainageways. Other inclusions are a few small areas of Kibbie soils.

The hazard of erosion is slight. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas remain wooded. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2b); woodland suitability group G; recreation group 3.

Metamora sandy loam, 2 to 6 percent slopes (MsB).—This soil is on knolls, ridges, and low mounds. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash. Also included are small eroded areas at higher elevations, which are the source of the overwash material. The surface layer in these eroded areas is grayish brown. Also included are a few small areas of Kibbie soils.

The hazard of erosion is slight to moderate. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-8 (3/2b); woodland suitability group G; recreation group 3.

Miami Series

The Miami series consists of well-drained, gently sloping to steep soils on till plains and moraines. These soils formed in loamy glacial till. In this county Miami soils are mapped separately and also in a complex with Owosso soils. The native vegetation consisted mainly of oak, maple, beech, and basswood.

In a representative profile the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is brown loam about 3 inches thick. The upper 5 inches of the subsoil is brown, firm light clay loam; the middle 9 inches is dark-brown, firm clay loam; and the lower 5 inches is yellowish-brown, firm clay loam. The underlying material, beginning at a depth of about 30 inches, is brown heavy loam.

Permeability is moderate, the available water capacity is high, and fertility is high.

Areas of less sloping Miami soils are well suited to farming. The steeper areas are well suited to openland and woodland wildlife habitat. Limitations for most nonfarm uses are slight to moderate on the less sloping soils. Miami soils are well suited to hardwoods but poorly suited to pines.

Most areas of less sloping Miami soils are used for crops. The steeper areas are used for permanent pasture or woodland or are in brush.

Representative profile of a Miami loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; weak, medium, granular structure; friable; less than 5 percent coarse fragments; slightly acid; abrupt, smooth boundary.

A2—8 to 11 inches, brown (10YR 5/3) loam; weak, coarse, granular structure; friable; less than 5 percent coarse fragments; medium acid; clear, wavy boundary.

B21—11 to 16 inches, brown (10YR 5/3) light clay loam; moderate, medium, subangular blocky structure; firm; 5 percent coarse fragments; medium acid; clear, wavy boundary.

B22t—16 to 25 inches, dark-brown (10YR 4/3) clay loam; strong, medium, subangular blocky structure; firm; dark-brown (7.5YR 3/2) organic-clay films on surfaces of peds; 5 percent coarse fragments; medium acid; gradual, wavy boundary.

B23t—25 to 30 inches, yellowish-brown (10YR 5/4) clay loam; moderate, coarse, subangular blocky structure; firm; dark-brown (7.5YR 3/2) organic-clay films on surfaces of peds; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

C—30 to 60 inches, brown (10YR 5/3) heavy loam; weak, coarse, subangular blocky structure; firm; 5 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is medium acid to neutral throughout. The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2) and is 7 to 10 inches thick. The A2 horizon is brown (10YR 5/3) or light yellowish brown (10YR 6/4). The B21 horizon is yellowish brown (10YR 5/4 or 5/6) or brown (10YR 5/3) and is heavy loam or light clay loam. The B22t horizon is yellowish brown (10YR 5/4 or 5/6), brown (10YR 5/3), or dark brown (10YR 4/3). The C horizon is light clay loam or loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Miami soils formed in the same kind of material as Brookston, Celina, and Conover soils. They lack the mottles in the solum that are in the Brookston, Celina, and Conover soils. They are finer textured in the upper part of the B horizon than Owosso soils. Miami soils are similar to Fox, Kendallville, Lapeer, and Tuscola soils. They have a finer texture in the C horizon than Fox soils and dominantly average a lower content of coarse fragments in the lower part of the solum than those soils. Miami soils average a lower content of coarse fragments in the B horizon than Kendallville soils. They have fewer sand separates throughout the profile than Lapeer soils and average a higher clay content in the Bt horizon than those soils. Miami soils lack the stratified soil material in the C horizon that is in the Tuscola soils, and they differ from those soils in having coarse fragments throughout.

Miami loam, 2 to 6 percent slopes (MuB).—This soil is on undulating plains. knolls, and low mounds on uplands. The areas are small to large in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash. Also included are small eroded areas, at higher elevations, that are the source of the overwash materials. These eroded areas have a brown surface layer. Other inclusions are small seep areas and wet depressions, and, mainly along the Maple River, small areas in which stratified gravelly sand is at a depth of 20 to 66 inches.

Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. Controlling erosion is the main concern of management.

Most areas of this soil are in crops. Small areas are wooded. This soil is well suited to farming if erosion is controlled. It has slight to moderate limitations for most recreational and urban developments. Capability unit IIe-2 (2.5a); woodland suitability group D; recreation group 2.

Miami loam, 2 to 6 percent slopes, moderately eroded (MuB2).—This soil is on knolls and side slopes of ridges. The areas are small to medium in size and are irregular in shape. Slopes are less than 100 feet long. This soil has a profile similar to the one described as representative of the series, except that the surface layer is brown and thinner.

Included with this soil in mapping are a few severely eroded spots at higher elevations. In these eroded areas most or all of the original surface layer has been removed by erosion and the clay loam subsoil is exposed. Also included are small areas of the somewhat poorly drained Conover soils in small depressions and narrow drainageways. Other inclusions are small seep areas and wet depressions and a few areas where cobblestones and pebbles are scattered on the surface but do not interfere with tillage.

Surface runoff is medium, and the hazard of erosion is slight to moderate. Controlling erosion and improving and maintaining organic-matter content are the main concerns of management.

Most areas of this soil are used for crops. Some areas are in permanent pasture. This soil is well suited to farming if erosion is controlled and organic-matter content is improved. It has slight to moderate limitations for recreational and urban developments. Capability unit IIe-2 (2.5a); woodland suitability group D; recreation group 2.

Miami loam, 6 to 12 percent slopes (MuC).—This rolling soil is on knolls, ridges, and in short, sloping areas near depressions and drainageways. The areas are small to medium in size and irregular in shape. Most slopes are 75 to 100 feet in length.

Included with this soil in mapping are small areas of the poorly drained Brookston soils in small, rounded depressions. Also included are a few small depressions in which the soil has a muck surface layer and a few areas of an eroded soil that has a thin, brown or dark-brown surface layer.

Surface runoff is medium, and the hazard of erosion is moderate. Controlling erosion is the main concern of management, but conserving moisture and maintaining organic-matter content are also important.

Most areas of this soil are used for crops. Some areas are wooded. This soil is moderately well suited to farming if erosion is controlled. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIe-5 (2.5a); woodland suitability group D; recreation group 2.

Miami loam, 6 to 12 percent slopes, moderately eroded (MuC2).—This soil is on knolls, ridges, and foot slopes on uplands. The areas are small to medium in size and are irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer is thinner and browner.

Included with this soil in mapping are a few small, severely eroded spots where the original surface layer has eroded away and the clay loam subsoil is exposed. Also included are small areas of Fox and Tuscola soils, and, in small depressions, poorly drained Brookston soils. Some small included areas have a sandy loam surface layer.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. Controlling erosion and conserving moisture are the main concerns of management, but improving and maintaining organic-matter content and soil tilth are also important.

Most areas of this soil are used for crops or permanent pasture. This soil is moderately suited to farming if erosion is controlled and moisture is conserved. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIIe-5 (2.5a); woodland suitability group D; recreation group 2.

Miami loam, 12 to 18 percent slopes, moderately eroded (MuD2).—This soil is on knolls, ridges, and hillsides near depressions and drainageways. The areas are small to medium in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer is brown and thinner. Most of the original surface layer has been eroded away, and the present surface layer is a mixture of the subsurface layer and the upper part of the subsoil.

Included with this soil in mapping are small severely eroded spots where the dark-brown clay loam subsoil is exposed. Also included are a few small areas where there are stones on the surface in numbers that interfere with tillage. Small areas of Fox soils are also included.

Surface runoff is rapid, and the hazard of erosion is severe. Controlling erosion is difficult because slopes are short and complex.

All of this soil was formerly used for crops, but a considerable acreage is now in woods or brush. Some areas

are used for permanent pasture. This soil is generally poorly suited to cultivated crops, but it is well suited to permanent pasture. It has severe limitations for most recreational and urban developments. Capability unit IVe-4 (2.5a); woodland suitability group D; recreation group 2.

Miami loam, 18 to 25 percent slopes, moderately eroded (MuE2).—This soil is on short, convex slopes near depressions and drainageways on uplands. The areas are small in size and irregular in shape. Slopes are 75 to 100 feet in length. This soil has a profile similar to the one described as representative of the series, except that the present surface layer is a mixture of the original subsurface layer and the upper part of the subsoil. It is brown in color.

Included with this soil in mapping are small, severely eroded areas where the brown or dark-brown clay loam subsoil is exposed. Also included are small areas along drainageways in which the surface layer is sandy loam. Small areas of Lapeer sandy loam are also included.

Surface runoff is rapid, and the hazard of erosion is severe to very severe. Control of erosion and use of equipment are difficult because the slopes are steep.

Most areas of this soil are now in permanent pasture or brush. A few areas are used for crops. This soil is poorly suited to cultivated crops. It has severe limitations for most recreational and urban developments. Capability unit VIe-2 (2.5a); woodland suitability group D; recreation group 2.

Miami clay loam, 12 to 18 percent slopes, severely eroded (MvD3).—This soil is on side slopes near depressions or drainageways on uplands. The areas are small in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the original surface and subsurface layers have been completely eroded away. The present surface layer is essentially the upper part of the original brown clay loam subsoil.

Included with this soil in mapping are small areas where cobblestones and pebbles are scattered on the surface. Also included are a few areas in which gullies have formed.

Surface runoff is rapid, and the hazard of erosion is very severe. The major limitations are erosion, slope, low organic-matter content, and poor soil tilth.

Almost all of this soil is in permanent vegetation. This soil is very poorly suited to cultivated crops but is moderately suited to forage crops. It has severe limitations for recreational and urban developments. Capability unit VIe-2 (2.5a); woodland suitability group D; recreation group 2.

Mine Pits

Mine pits (Mw) are areas from which the soil and underlying material have been removed during shale or coal mining operations. These pits range from a few feet to as much as 50 feet in depth. Both active and abandoned pits are in this unit. The areas are near Corunna and Henderson.

These pits ordinarily have no use other than as a source of coal or shale. Some of the abandoned pits, however, provide a limited wildlife refuge. Capability unit VIIIs-1 (Sa); not placed in a woodland suitability group or recreation group.

Newaygo Series

The Newaygo series consists of well-drained, gently sloping soils on outwash plains and beach ridges. These soils formed in sandy loam and loam, 24 to 40 inches thick, over gravelly sand. The native vegetation consisted mainly of sugar maple, elm, and ash.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The upper 10 inches of the subsoil is dark-brown, very friable sandy loam; the middle 6 inches is dark yellowish-brown, firm heavy loam; and the lower part is dark-brown, firm sandy clay loam. The underlying material, beginning at a depth of about 34 inches, is pale-brown gravelly coarse sand.

Permeability is moderate in the subsoil and rapid in the underlying material. The available water capacity is moderate, and fertility is medium. Surface runoff is slow.

Newaygo soils are well suited to farming. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are slight. These soils are well suited to woodland.

Most areas of these soils are used for crops. A few areas remain in woodland or are used for pasture.

Representative profile of Newaygo sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; weak, medium, granular structure; friable; less than 5 percent gravel; slightly acid; abrupt, smooth boundary.

Bir—8 to 18 inches, dark-brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; very friable; less than 5 percent gravel; slightly acid; clear, wavy boundary.

B21t—18 to 24 inches, dark yellowish-brown (10YR 4/4) heavy loam; moderate, fine, subangular blocky structure; firm; clay films on surfaces of peds; 15 percent fine gravel; slightly acid; gradual, wavy boundary.

B22t—24 to 34 inches, dark-brown (7.5YR 4/4) sandy clay loam; moderate, coarse, subangular blocky structure; firm; clay films on surfaces of peds; 15 percent gravel; neutral; abrupt, irregular boundary.

IIC—34 to 60 inches, pale-brown (10YR 6/3) gravelly coarse sand; single grain; loose; 30 percent gravel; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is slightly acid or neutral throughout. The Ap horizon is dark grayish brown (10YR 4/2) or very dark grayish brown (10YR 3/2). The A2 horizon, where present, is light brownish gray (10YR 6/2) and is 1 to 3 inches thick. The Bir horizon is loam or sandy loam. The B21t horizon is heavy loam, sandy clay loam, or light clay loam; it is gravelly in places. The IIC horizon is brown (10YR 5/3), light yellowish brown (10YR 6/4), or pale brown (10YR 6/3) and is sand or coarse sand or gravelly or very gravelly analogs of these textures. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Newaygo soils are similar to Kendallville and Mancelona soils. They have a coarser texture in the C horizon than Kendallville soils. Newaygo soils have a finer texture in the solum than Mancelona soils in horizons of similar horizon designation.

Newaygo sandy loam, 2 to 6 percent slopes (NyB).—This soil is on knolls, ridges, and low mounds on plains.

The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small depressional areas that are covered by a thin layer of loamy overwash. This overwash generally is dark yellowish brown or yellowish brown. Also included are a few small eroded areas, at higher elevations, that are the source of the overwash material. Also included are a few areas, generally near the base of low beach ridges, where the loam or clay loam underlying material is at depths of 42 to 66 inches.

The hazard of erosion is slight to medium. The main concern of management is controlling erosion, but conserving moisture is also important.

Most areas of this soil are used for crops. A few small areas remain wooded. This soil is well suited to farming if erosion is controlled and moisture conserved. It has slight limitations for recreational and urban developments. Capability unit IIe-3 (3a); woodland suitability group U; recreation group 2.

Ottokee Series

The Ottokee series consists of moderately well drained, nearly level soils on outwash plains and till plains. These soils formed in sand. The native vegetation consisted mainly of aspen, black cherry, oak, and maple.

In a representative profile the surface layer is dark grayish-brown loamy sand about 9 inches thick. The subsurface layer, about 8 inches thick, is grayish-brown sand mottled with yellowish brown. The subsoil is about 33 inches thick. It consists of thin, interbedded layers of pale-brown, loose sand and dark-brown, very friable heavy loamy sand. The underlying material, beginning at a depth of about 50 inches, is very pale brown sand mottled with strong brown.

Permeability is rapid, the available water capacity is low, and fertility is low. Surface runoff is slow.

Ottokee soils are moderately suited to farming if moisture is conserved and fertility is improved and maintained. They are poorly suited to wetland wildlife habitat. Limitations for most nonfarm uses are moderate. These soils are moderately well suited to pines and aspen and poorly suited to hardwoods.

Most areas of these soils are used for crops. Some areas are used for woodland or pasture.

Representative profile of Ottokee loamy sand:

Ap—0 to 9 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; neutral; abrupt, smooth boundary.

A2—9 to 17 inches, grayish-brown (10YR 5/2) sand; common, fine, distinct, yellowish-brown (10YR 5/8) mottles; very weak, coarse, subangular blocky structure; very friable; neutral; abrupt, wavy boundary.

A&B—17 to 50 inches, pale-brown (10YR 6/3) sand (A22); single grain; loose; bands of dark-brown (7.5YR 4/4) heavy loamy sand (Bt); massive; very friable; bands are ⅛ inch to 3 inches thick and are 1 to 5 inches apart; common, fine, faint, yellowish-brown (10YR 5/8) mottles; clay bridges connect sand grains; slightly acid; clear, wavy boundary.

C—50 to 60 inches, very pale brown (10YR 7/3) sand; common, fine, distinct, strong-brown (7.5YR 5/8) mottles; single grain; loose; mildly alkaline.

The solum ranges from 45 to 70 inches in thickness and from medium acid to mildly alkaline throughout. The Ap horizon is dark brown (10YR 3/3), dark grayish brown (10YR 4/2), or very dark grayish brown (10YR 3/2) and is 6 to 10 inches thick. The Bt part of the A&B horizon is light sandy loam or heavy loamy sand. The cumulative thickness of the Bt horizon is 6 inches or more. The C horizon has slight effervescence in a few places.

The cumulative thickness of the Bt bands in these soils is more than that defined as the range for the series. Also, the mottles are nearer the surface. These differences alter the usefulness and behavior of these soils for some farm and nonfarm uses.

Ottokee soils formed in the same kind of material as Spinks soils. These soils are similar to Plainfield soils, slightly acid variant. They have mottles in the solum that are lacking in Spinks soils and Plainfield soils, slightly acid variant. Also, they have bands designated as Bt horizon material that are finer textured than other parts of the profile, which are lacking in Plainfield soils, slightly acid variant.

Ottokee loamy sand, 0 to 2 percent slopes (OkA).—This soil is on flats on plains. The areas are small to medium in size and irregular in shape. Included with this soil in mapping are small areas of the poorly drained Granby soils in depressions and drainageways.

This soil is very susceptible to soil blowing. Permeability is rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture, control of soil blowing, and improving and maintaining fertility and organic-matter content. Removing excess water in spring is also a concern in some areas.

Most areas of this soil are used for crops. Some areas are used for pasture or woodland. This soil is moderately suited to farming if moisture is conserved and fertility is maintained. It has moderate limitations for most recreational and urban developments. Capability unit IIIs-4 (5a); woodland suitability group E; recreation group 1.

Owosso Series

The Owosso series consists of well-drained, gently sloping to moderately steep soils on till plains and moraines. These soils formed in sandy loam material, 20 to 40 inches thick, and in the underlying loamy glacial till. In this county Owosso soils are mapped only in a complex with Miami soils. The native vegetation consisted mainly of oak, maple, beech, and hickory.

In a representative profile the surface layer is dark grayish-brown sandy loam about 8 inches thick. The subsurface layer is brown sandy loam about 5 inches thick. The upper 17 inches of the subsoil is dark-brown, friable sandy loam; the lower 8 inches is yellowish-brown, firm clay loam. The underlying material, beginning at a depth of about 38 inches, is yellowish-brown heavy loam.

Permeability is moderately rapid in the upper part of the subsoil and moderately slow in the lower part and in the underlying material. The available water capacity is moderate, and fertility is medium.

The areas of less sloping soils are well suited to farming. The steeper soils are well suited to pasture and forage crops. They are well suited to openland wildlife habitat. Limitations for nonfarm uses are slight to moderate on the less sloping soils. Owosso soils are well suited to hardwoods but are poorly suited to pines.

Most areas of these soils are used for crops. A few areas are used for pasture or remain in woodland.

Representative profile of Owosso sandy loam, from an area of Owosso-Miami sandy loams:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) sandy loam; weak, fine, granular structure; friable; less than 5 percent gravel; slightly acid; abrupt, smooth boundary.

A2—8 to 13 inches, brown (10YR 5/3) sandy loam; weak, medium, granular structure; friable; less than 5 percent gravel; slightly acid; clear, wavy boundary.

B1—13 to 30 inches, dark-brown (7.5YR 4/4) sandy loam; weak, fine, subangular blocky structure; friable; less than 5 percent gravel; slightly acid; abrupt, wavy boundary.

IIBt—30 to 38 inches, yellowish-brown (10YR 5/4) clay loam; moderate, medium, subangular blocky structure; firm; clay films on surfaces of peds; 5 percent coarse fragments; neutral; abrupt, wavy boundary.

IIC—38 to 60 inches, yellowish-brown (10YR 5/4) heavy loam; weak, coarse, subangular blocky structure; firm; 10 percent coarse fragments; mildly alkaline; slight effervescence.

The solum ranges from 24 to 42 inches in thickness and is medium acid or neutral throughout. The A1 horizon, where present, is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2). The IIBt horizon is dark yellowish brown (10YR 4/4) or yellowish brown (10YR 5/4). The IIC horizon is light clay loam or loam. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Owosso soils formed in the same kind of material as Metamora soils. They lack mottles in the solum that are in the Metamora soils. In this county Owosso soils are mapped in a complex with Miami soils. They have a coarser texture in the upper part of the B horizon than Miami soils. Owosso soils are similar to Kendallville, Menominee, and Tuscola soils. They average a lower content of coarse fragments in the B horizon than Kendallville soils. They have a finer texture in the upper part of the solum than Menominee soils. Owosso soils lack the stratified soil material in the C horizon that is in the Tuscola soils, and they have coarse fragments throughout, which are lacking in those soils.

Owosso-Miami sandy loams, 2 to 6 percent slopes (OmB).—This complex is on knolls, ridges, and low mounds on uplands. The areas are small to medium in size and irregular in shape. Owosso sandy loam makes up about 55 percent of the acreage, and Miami sandy loam makes up about 45 percent. Miami sandy loam is mainly on longer slopes of 4 to 6 percent, and Owosso sandy loam is more gently sloping in the intervening areas. Owosso and Miami soils have profiles similar to those described as representative of the series, except that the surface layer of the Miami soil is sandy loam.

Included in mapping are small areas of poorly drained Brookston or Breckenridge soils in small depressions and narrow drainageways. Also included are small areas that are loamy sand to depths of 30 to 38 inches. Small eroded areas, at higher elevations, are also included.

Surface runoff is slow to medium, and the hazard of erosion is slight to moderate. The main concern of management is controlling erosion.

Most areas of this complex are used for crops. A few areas remain in woodland or are used for permanent pasture. This complex is well suited to farming if erosion is controlled. It has slight to moderate limitations for most recreational and urban developments. Capability unit IIe-3 (3/2a-2.5a); woodland suitability group D; recreation group 2.

Owosso-Miami sandy loams, 6 to 12 percent slopes (OmC).—This complex is on knolls, ridges, and low mounds and on short, convex slopes near depressions and drainageways on uplands. The areas are small to medium in size and irregular in shape. Owosso sandy loam makes up about 40 to 70 percent of the acreage, and Miami sandy loam makes up about 30 to 60 percent.

Included in mapping are small eroded areas that have lost much of the original surface layer through erosion. In these eroded areas the present surface layer is brown or dark brown. Also included are small, widely scattered spots that are loamy sand to a depth of 30 to 40 inches.

Surface runoff is medium, and the hazard of erosion is moderate. The main concern of management is controlling water erosion, but conserving moisture is also important.

Most areas of this complex are used for crops. A few areas are wooded or are in permanent pasture. This complex is moderately suited to farming if erosion is controlled. It is well suited to pasture and forage crops. It has moderate to severe limitations for most recreational and urban developments. Capability unit IIIe-6 (3/2a-2.5a); woodland suitability group D; recreation group 2.

Owosso-Miami sandy loams, 12 to 18 percent slopes, moderately eroded (OmD2).—This complex is on uplands. The areas are small in size and irregular in shape. The slopes are short and complex. Owosso sandy loam makes up about 65 percent of the acreage, and Miami sandy loam makes up about 35 percent. Erosion has removed much of the original surface layer, and the present surface layer is a mixture of the original surface and subsurface layers and the upper part of the subsoil. The present surface layer is brown or dark brown. Included in mapping are small spots that are loamy sand to a depth of 30 to 40 inches.

Surface runoff is medium to rapid, and the hazard of erosion is moderate to severe. The main concerns of management are controlling water erosion and conserving moisture.

Most areas of this complex are in permanent pasture. Some areas are in woodland or in permanent vegetation. This complex is poorly suited to farming, but it is suited to pasture and forage crops. It has severe limitations for most recreational and urban developments. Capability unit IVe-4 (3/2a-2.5a); woodland suitability group D; recreation group 2.

Plainfield Series, Slightly Acid Variant

The Plainfield series, slightly acid variant, consists of well-drained, gently sloping to rolling soils on outwash plains, moraines, and stream terraces. These soils formed in sand. The native vegetation consisted mainly of aspen, red pine, black cherry, and oak.

In a representative profile the surface layer is dark-brown loamy sand about 8 inches thick. The subsoil is yellowish-brown, loose sand about 20 inches thick. The underlying material, beginning at a depth of about 28 inches, is very pale brown sand (fig. 8).

Permeability is rapid, the available water capacity is low, and fertility is low. Surface runoff is slow.

Plainfield soils, slightly acid variant, are very poorly suited to farming because of low fertility and low soil moisture. They are poorly suited to openland wildlife habitat because of low fertility and low soil moisture. Limitations for nonfarm uses are slight to moderate on the less sloping soils. These soils are moderately to well suited to pines and aspen but poorly suited to hardwoods.

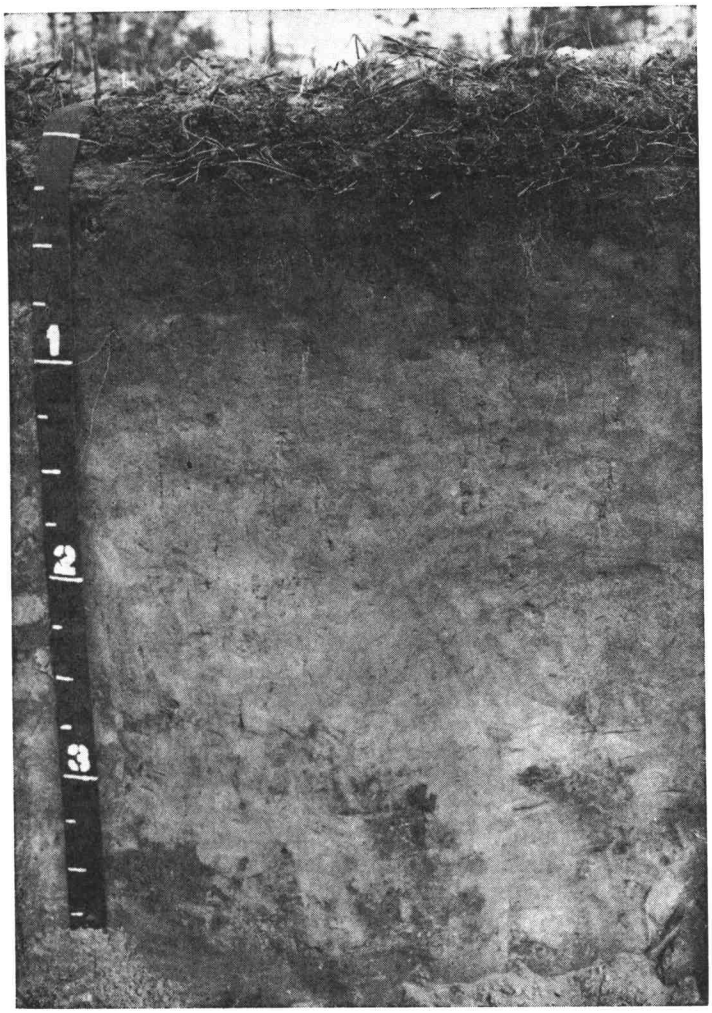

Figure 8.—**Profile of Plainfield loamy sand, slightly acid variant. This soil holds only small amounts of water that crops can use. The sandy material is loose and lacks structure. The numbers refer to depth in feet.**

Most areas of these soils are used for pasture or woodland or are in permanent vegetation. Small areas are used for crops.

Representative profile of a Plainfield loamy sand, slightly acid variant:

Ap—0 to 8 inches, dark-brown (10YR 3/3) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

B—8 to 28 inches, yellowish-brown (10YR 5/4) sand; single grain; loose; slightly acid; gradual, wavy boundary.

C—28 to 60 inches, very pale brown (10YR 7/4) sand; single grain; loose; mildly alkaline.

The solum ranges from 20 to 36 inches in thickness and from slightly acid to mildly alkaline throughout. The A1 horizon, where present, is very dark grayish brown (10YR 3/2) and is 1 to 3 inches thick. The Ap horizon is dark grayish brown (10YR 4/2) or dark brown (10YR 3/3) and is 7 to 10 inches thick. The C horizon is light yellowish brown (10YR 6/4), brownish yellow (10YR 6/6), or very pale brown (10YR 7/4). It has slight effervescence in a few places.

Plainfield soils, slightly acid variant, formed in the same kind of material as Granby soils. These soils lack the gray or grayish matrix colors in the solum that are in the Granby soils. They are similar to Abscota, Mancelona, Ottokee, and Spinks soils. They have a coarser texture in the upper part of the profile than Abscota soils. Plainfield soils, slightly acid variant, lack a Bt horizon or a horizon with bands designated as Bt that has a finer texture than the other parts of the profile, which are in the Mancelona, Ottokee, and Spinks soils. They lack the coarse fragments in the C horizon that are in the Mancelona soils.

Plainfield loamy sand, slightly acid variant, 2 to 6 percent slopes (PfB).—This soil is on knolls and ridges on uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small eroded areas that have a yellowish-brown surface layer. Also included are areas that have a surface layer of fine sand or medium sand. Also included are areas of the poorly drained Granby soils in small depressions and narrow drainageways.

This soil is very susceptible to soil blowing if the surface is exposed. Permeability is rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture, control of soil blowing, and improving and maintaining fertility.

Most areas of this soil are used for pasture or woodland, or they are in permanent vegetation. This soil is very poorly suited to farming, unless irrigated. It has slight to moderate limitations for recreational and urban developments. Capability unit VIs-1 (5a); woodland suitability group E; recreation group 1.

Plainfield loamy sand, slightly acid variant, 6 to 12 percent slopes (PfC).—This soil is on rolling uplands. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small eroded areas where the present surface layer is yellowish brown. Also included are a few small areas of Spinks soils.

This soil is very susceptible to soil blowing. The hazard of erosion is slight. Permeability is rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture, control of soil blowing, and improving and maintaining fertility.

Most areas of this soil are used for pasture or woodland, or they are in permanent vegetation. This soil is very poorly suited to farming. It has moderate limitations for most recreational and urban developments. Capability unit VIs-1 (5a); woodland suitability group E; recreation group 1.

Richter Series

The Richter series consists of somewhat poorly drained, nearly level soils on outwash plains and till plains. These soils formed in water-laid materials that consist of stratified sandy loam, loamy sand, and loamy fine sand. The native vegetation consisted mainly of oak, maple, and ash.

In a representative profile the surface layer is very dark grayish-brown loamy fine sand about 10 inches thick. The subsurface layer, about 3 inches thick, is pale-brown light sandy loam mottled with yellowish brown. The upper 5 inches of the subsoil is reddish-brown, very friable loamy sand mottled with yellow; the lower 8 inches is light brownish-gray, friable heavy sandy loam mottled with

yellowish brown. The underlying material, beginning at a depth of about 26 inches, is light-gray, stratified sandy loam, loamy sand, and loamy fine sand mottled with strong brown.

Permeability is moderately rapid, the available water capacity is moderate, and fertility is medium. Surface runoff is slow.

Richter soils are well suited to farming if excess water is removed. They are well suited to openland wildlife habitat. Limitations for nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few small areas are in woodland.

Representative profile of Richter loamy fine sand:

Ap—0 to 10 inches, very dark grayish-brown (10YR 3/2) loamy fine sand; weak, fine, granular structure; friable; neutral; abrupt, smooth boundary.

A2—10 to 13 inches, pale-brown (10YR 6/3) light sandy loam; common, medium, distinct, yellowish-brown (10YR 5/6) mottles; weak, coarse, granular structure; very friable; neutral; clear, wavy boundary.

Bir—13 to 18 inches, reddish-brown (5YR 4/4) loamy sand; common, medium, prominent, yellow (10YR 7/8) mottles; very weak, medium, subangular blocky structure; very friable; neutral; clear, wavy boundary.

B't—18 to 26 inches, light brownish-gray (10YR 6/2) heavy sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; clay bridges connect sand grains; mildly alkaline; abrupt, wavy boundary.

C—26 to 60 inches, light-gray (10YR 7/1) stratified sandy loam, loamy sand, and loamy fine sand; few, medium, distinct, strong-brown (7.5YR 5/8) mottles; massive; very friable; mildly alkaline; slight effervescence.

The solum ranges from 20 to 40 inches in thickness and is medium acid to neutral above the B't horizon. The A1 horizon is very dark gray (10YR 3/1) and is 2 to 4 inches thick. The Ap horizon is very dark gray (10YR 3/1) or very dark grayish brown (10YR 3/2) and is 6 to 10 inches thick. The A2 horizon is light brownish gray (10YR 6/2) or pale brown (10YR 6/3). The Bir horizon is dark yellowish brown (10YR 4/4), dark brown (7.5YR 4/4), or reddish brown (5YR 4/4). The Bt horizon is sandy clay loam, sandy loam, or loam. It contains thin strata of loamy sand, loamy fine sand, and sandy clay loam in a few places. The C horizon is grayish brown (10YR 5/2) or light gray (10YR 7/1). It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Richter soils are similar to Belding, Kibbie, and Locke soils. These soils have stratified soil material in the C horizon that is lacking in Belding soils. They have a coarser texture throughout the solum than Kibbie soils, and they are less grayish in all or part of the B horizon than those soils. Richter soils have a less grayish matrix color in the upper part of the B horizon than Locke soils, and they lack the coarse fragments throughout the profile that are in the Locke soils.

Richter loamy fine sand, 0 to 2 percent slopes (RhA).—This soil is commonly associated with drainageways in the lowlands. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the poorly drained Colwood or Gilford soils. Also included are small areas where the slope is 2 to 6 percent. A few small areas of the somewhat poorly drained Gladwin soils are also included.

The main concern of management is removal of excess water.

Most areas of this soil are used for crops. Some small areas remain in woodland. This soil is well suited to farming if excess water is removed. It has moderate to severe limitations for recreational and urban developments. Capability unit IIw-6 (3b); woodland suitability group G; recreation group 3.

Sebewa Series

The Sebewa series consists of poorly drained, nearly level soils on outwash plains and valley trains. These soils formed in gravelly loamy materials, 20 to 40 inches thick, over gravelly sand. The native vegetation consisted mainly of ash, soft maple, swamp white oak, and elm.

In a representative profile the surface layer is very dark brown loam about 11 inches thick. The upper 8 inches of the subsoil is grayish-brown, firm clay loam mottled with yellowish brown; the lower 11 inches is light brownish-gray, friable gravelly clay loam mottled with dark grayish brown and yellowish brown. The underlying material, beginning at a depth of about 30 inches, is light brownish-gray very gravelly coarse sand.

Permeability is moderate in the subsoil and very rapid in the underlying material. The available water capacity is moderate, and fertility is high. Surface runoff is very slow or ponded.

Sebewa soils are well suited to farming if excess water is removed. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for pasture or woodland.

Representative profile of Sebewa loam:

Ap—0 to 8 inches, very dark brown (10YR 2/2) loam; moderate, fine, granular structure; friable; less than 5 percent gravel; neutral; abrupt, smooth boundary.

A12—8 to 11 inches, very dark brown (10YR 2/2) loam; weak, fine, subangular blocky structure; friable; less than 5 percent gravel; neutral; gradual, wavy boundary.

B21tg—11 to 19 inches, grayish-brown (10YR 5/2) clay loam; common, fine, distinct, yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; firm, very dark brown (10YR 2/2) organic-clay films on surfaces of peds in upper part; 10 percent gravel; mildly alkaline; gradual, wavy boundary.

B22tg—19 to 30 inches, light brownish-gray (10YR 6/2) gravelly clay loam; common, medium, distinct, dark grayish-brown (10YR 4/2) and yellowish-brown (10YR 5/6) mottles; moderate, medium, subangular blocky structure; friable; clay films on surfaces of peds; 20 percent gravel; mildly alkaline; abrupt, irregular boundary.

IIC—30 to 60 inches, light brownish-gray (10YR 6/2) very gravelly coarse sand; single grain; loose; 35 percent gravel; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is slightly acid to mildly alkaline throughout. The A horizon is very dark grayish brown (10YR 3/2), very dark gray (10YR 3/1), or very dark brown (10YR 2/2) and is 10 to 13 inches thick. The B horizon is gray (10YR 5/1), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). It is sandy clay loam or clay loam or gravelly analogs of these textures.

The IIC horizon is gray (10YR 5/1 or 6/1) or light brownish gray (10YR 6/2). It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

Sebewa soils formed in the same kind of material as Fox and Matherton soils. These soils have a thicker or darker colored A horizon than Fox soils, and they have mottles in the solum that are lacking in Fox soils. They have a thicker, dark-colored A horizon than Matherton soils. Sebewa soils are similar to Gilford soils. They have a finer texture in the B horizon than Gilford soils.

Sebewa loam (0 to 2 percent slopes) (Sd).—This soil is in swales, in depressions, and on broad flats in the lowlands. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of somewhat poorly drained Matherton soils at slightly higher elevations and small areas of poorly drained Berville soils in depressions. Also included are a few areas where stones are on the surface and throughout the profile. The stones in the included areas are in numbers that interfere with tillage. Also included are a few small areas in depressions where the surface layer is muck.

This soil is ponded in some areas early in spring and after heavy rains. The main concern of management is removal of excess water.

Most areas of this soil are used for crops. A few areas are used for pasture or woodland. This soil is well suited to farming if excess water is removed. It has severe limitations for recreational and urban developments. Capability unit IIw-6 (3c); woodland suitability group W; recreation group 4.

Shoals Series

The Shoals series consists of somewhat poorly drained, nearly level soils on flood plains of the major streams and rivers. These soils formed in loamy water-laid materials. The native vegetation consisted mainly of elm, swamp white oak, ash, and red maple.

In a representative profile the surface layer is dark-gray loam about 7 inches thick. The upper 7 inches of the subsoil is dark-gray, friable loam mottled with dark brown; the lower 6 inches is grayish-brown, friable loam mottled with light olive brown. The underlying material, beginning at a depth of about 20 inches, is light brownish-gray heavy loam mottled with light olive brown.

Permeability is moderate, the available water capacity is high, and fertility is high. Surface runoff is slow. These soils are flooded in spring in most years, but they are flooded only occasionally during the growing season.

Shoals soils are generally poorly suited to farming because of wetness and the hazard of flooding. They are moderately suited to wetland wildlife habitat. Limitations for nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are used for pasture or woodland. A few areas are used for crops.

Representative profile of Shoals loam:

Ap—0 to 7 inches, dark-gray (10YR 4/1) loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

B21g—7 to 14 inches, dark-gray (10YR 4/1) loam; common, fine, distinct, dark-brown (7.5YR 3/2) mottles; weak, coarse, granular structure; friable; neutral; gradual, wavy boundary.

B22g—14 to 20 inches, grayish-brown (10YR 5/2) loam; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, coarse, granular structure; friable; mildly alkaline; gradual, wavy boundary.

Cg—20 to 60 inches, light brownish-gray (10YR 6/2) heavy loam; many (45 percent), medium, distinct, light olive-brown (2.5Y 5/6) mottles; massive; friable; mildly alkaline.

The solum ranges from 20 to 40 inches in thickness and is neutral or mildly alkaline throughout. Depth to mottling is 7 to 18 inches. The Ap horizon is dark grayish brown (10YR 4/2) or dark gray (10YR 4/1) and is 6 to 10 inches thick. The C horizon is silt loam, loam, light clay loam, or light silty clay loam and is commonly stratified. It contains strata of black (10YR 2/1 or N 2/0) organic material, 2 to 5 inches thick, in a few places. The C horizon has slight effervescence below a depth of 35 inches in a few places.

Shoals soils formed in the same kind of material as Eel and Sloan soils. These soils dominantly have more gray or grayish colors in the B horizon than Eel soils. They have a thinner or lighter colored A horizon than Sloan soils. Shoals soils have drainage similar to that of Algansee and Ceresco soils. They have a finer texture throughout than Algansee and Ceresco soils.

Shoals loam (0 to 2 percent slopes) (Sh).—This soil is on the flood plains of major streams or rivers. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are some small areas of the poorly drained Sloan soils. Also included are a few small areas that have pockets of gravelly sand in the underlying material.

This soil is flooded in spring in most years, but it is flooded only occasionally during the growing season. The main concerns of management are removing excess water and flooding, but protecting crops from frost is also important.

Most areas of this soil are used for pasture or woodland. A few areas are used for crops. This soil is generally poorly suited to farming. It has severe limitations for recreational and urban developments. Capability unit Vw-3 (L-2c); woodland suitability group O; recreation group 6.

Sloan Series

The Sloan series consists of poorly drained, nearly level soils on flood plains of streams and rivers. These soils formed in loamy water-laid materials. The native vegetation consisted of elm, swamp white oak, ash, and soft maple.

In a representative profile the surface layer is very dark brown loam about 12 inches thick. The upper 11 inches of the subsoil is gray, friable loam mottled with light olive brown; the lower 11 inches is light brownish-gray, friable loam mottled with dark brown. The underlying material, beginning at a depth of about 34 inches, is light brownish-gray loam mottled with dark brown.

Permeability is moderate, the available water capacity is high, and fertility is high. Surface runoff is slow to ponded. This soil is near enough to the level of the stream that it floods in most years during the growing season.

Sloan soils are generally poorly suited to farming because of excess wetness, the hazard of flooding, and the hazard of frost. They are well suited to wetland wildlife habitat. Limitations for nonfarm uses are severe. These soils are poorly suited to woodland.

Most areas of these soils are in woodland or unimproved pasture.

Representative profile of Sloan loam:

Ap—0 to 12 inches, very dark brown (10YR 2/2) loam; moderate, fine, granular structure; friable; neutral; abrupt, smooth boundary.

B21g—12 to 23 inches, gray (10YR 5/1) loam; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, fine, subangular blocky structure; friable; very dark gray (10YR 3/1) organic films on surfaces of peds in upper part; neutral; gradual, wavy boundary.

B22g—23 to 34 inches, light brownish-gray (10YR 6/2) loam; common, medium, distinct, dark-brown (7.5YR 4/4) mottles; very weak, medium, subangular blocky structure; friable; neutral; gradual, wavy boundary.

Cg—34 to 60 inches, light brownish-gray (10YR 6/2) loam; many, medium, distinct, dark-brown (7.5YR 4/4) mottles; massive; friable; mildly alkaline.

The solum ranges from 20 to 40 inches in thickness and from slightly acid to mildly alkaline throughout. The Ap horizon is black (10YR 2/1), very dark brown (10YR 2/2), or very dark gray (10YR 3/1) and is 10 to 14 inches thick. The Cg horizon is gray (10YR 5/1), grayish brown (10YR 5/2), or light brownish gray (10YR 6/2). It commonly contains strata of light silty clay loam, light clay loam, or silt loam. In a few places the Cg horizon contains thin strata of sandy loam, fine sand, and black (10YR 2/1 or N 2/0) organic material.

Sloan soils formed in the same kind of material as Eel and Shoals soils. These soils have dominantly more gray or grayish colors in the B horizon than Eel soils. They have a thicker or darker colored A horizon than Shoals soils. Sloan soils are similar to Cohoctah and Glendora soils, but they have a finer texture throughout than those soils.

Sloan loam (0 to 2 percent slopes) (Sn).—This soil is on flood plains of the major streams and rivers. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the somewhat poorly drained Shoals soils at slightly higher elevations. Also included are some small areas that have pockets of gravelly sand in the underlying material.

Flooding occurs during the growing season in most years. The main concerns of management are removal of excess water and protection from flooding and frost damage.

Most areas of this soil are used for woodland, or they are in unimproved pasture. This soil is generally poorly suited to farming. It has severe limitations for recreational and urban developments. Capability unit Vw-3 (L-2c); woodland suitability group O; recreation group 6.

Spinks Series

The Spinks series consists of well-drained, nearly level to moderately steep soils on outwash plains, till plains, stream terraces, and moraines. These soils formed in sand. The native vegetation consisted mainly of oak, maple, hickory, red pine, and white pine.

In a representative profile the surface layer is dark grayish-brown loamy sand about 8 inches thick. The subsurface layer is yellowish-brown sand about 21 inches thick. The subsoil is 15 inches thick. It consists of thin, interbedded layers of yellow, loose sand and dark-brown, very friable heavy loamy sand. The underlying material, beginning at a depth of about 44 inches, is very pale brown sand.

Permeability is moderately rapid, the available water capacity is low, and fertility is low.

Areas of less sloping Spinks soils are moderately suited to farming if moisture is conserved and fertility is maintained. Limitations for nonfarm uses are slight on the less sloping soils. The less sloping areas are moderately well suited to pines, but poorly to moderately suited to hardwoods. The steeper areas are well suited to woodland and openland wildlife habitat.

Most areas of the less sloping soils are used for crops or pasture. The steeper areas are in woodland or are idle or in brush.

Representative profile of a Spinks loamy sand:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loamy sand; weak, fine, granular structure; very friable; slightly acid; abrupt, smooth boundary.

A2—8 to 29 inches, yellowish-brown (10YR 5/6) sand; single grain; loose; slightly acid; abrupt, wavy boundary.

A&B—29 to 44 inches, yellow (10YR 7/6) sand (A2 horizon); single grain; loose; bands of dark-brown (7.5YR 4/4) heavy loamy sand (Bt horizon); massive; very friable; bands are ¼ to 3 inches thick and are continuous and discontinuous; slightly acid; abrupt, wavy boundary.

C—44 to 60 inches, very pale brown (10YR 7/3) sand; single grain; loose; mildly alkaline.

The solum ranges from 36 to 50 inches in thickness and is slightly acid or neutral throughout. The Ap horizon is brown (10YR 4/3) or dark grayish brown (10YR 4/2) and is 6 to 10 inches thick. The first Bt band in the A&B horizon is at a depth of 24 to 36 inches. The Bt bands in the A&B horizon are light sandy loam or heavy loamy sand. The cumulative thickness of the Bt bands in the A&B horizon is 6 inches or more. The C horizon has slight effervescence in a few places.

Spinks soils formed in the same kind of material as Ottokee soils. These soils lack mottles in the solum that are in the Ottokee soils. They are similar to Boyer and Mancelona soils and the slightly acid variant of the Plainfield soils. Spinks soils have a coarser texture than Boyer soils in horizons with similar horizon designations. Spinks soils have bands of Bt material as part of an A&B horizon, rather than a Bt horizon as do Mancelona soils, and they typically average a lower content of clay in the part of the profile designated Bt than those soils. Unlike the slightly acid variant of the Plainfield soils, they have bands of Bt material that typically averages a higher content of clay than the other parts of the profile.

Spinks loamy sand, 0 to 2 percent slopes (SpA).—This soil is on ridgetops on uplands and on low, broad benches adjacent to glacial drainageways in lowlands. The areas are small in size and irregular in shape. This soil has a profile similar to the one described as representative of the series, except that the surface layer is generally dark brown. Included with this soil in mapping are small areas of the moderately well drained Ottokee soils or well-drained Menominee soils.

Surface runoff is slow. This soil is very susceptible to soil blowing if the surface is exposed. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture and control of soil blowing, but improving fertility is also important.

Most areas of this soil are in permanent pasture or forage crops. A few areas are used for cultivated crops. This soil is moderately suited to farming if moisture is conserved, soil blowing is controlled, and fertility is maintained. It has slight limitations for recreational and urban

developments. Capability unit IIIs-4 (4a); woodland suitability group E; recreation group 1.

Spinks loamy sand, 2 to 6 percent slopes (SpB).—This soil is on ridges, knolls, and low mounds on uplands. The areas are small to medium in size and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of somewhat poorly drained, sandy soils in depressions. Also included are a few areas where this soil is underlain by clay loam at depths of 42 to 66 inches.

Surface runoff is slow. This soil is very susceptible to soil blowing if the surface is exposed. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are conserving moisture and control of soil blowing. Improving fertility and maintaining the organic-matter content are also important.

Most areas of this soil are used for pasture. Small areas are used for forage crops or are wooded. This soil is moderately suited to farming if moisture is conserved, soil blowing is controlled, and fertility is maintained. It has slight limitations for recreational and urban developments. Capability unit IIIs-4 (4a); woodland suitability group E; recreation group 1.

Spinks loamy sand, 6 to 12 percent slopes (SpC).—This soil is on knolls, ridges, and foot slopes on uplands. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small, eroded areas where the original surface layer has been completely removed by erosion or where the original surface layer has been mixed with the subsurface layers. Also included are a few small wet areas in depressions where the surface layer is muck.

Surface runoff is slow to medium, and the hazard of erosion is moderate. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are controlling water erosion and conserving moisture, but improving and maintaining fertility and organic-matter content are also important.

Most areas of this soil are used for woodland or pasture. Very few areas are used for forage crops or for cultivated crops. This soil is moderately suited to farming if erosion is controlled, soil moisture is conserved, and fertility is maintained. It has moderate limitations for most recreational and urban developments. Capability unit IIIe-9 (4a); woodland suitability group E; recreation group 1.

Spinks loamy sand, 12 to 18 percent slopes (SpD).—This soil is in hilly areas and on short slopes near drainageways or depressions on uplands. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the poorly drained Granby soils in depressions and drainageways. Also included are small areas where the soil is underlain by clay loam at depths ranging from 42 to 66 inches. A few included areas of gravel are in the subsoil.

Surface runoff is medium, and the hazard of erosion is moderate to severe. Permeability is moderately rapid, the available water capacity is low, and fertility is low. The main concerns of management are controlling erosion and conserving moisture, but improving and maintaining fertility and organic-matter content are also important.

Most areas of this soil are used for pasture or woodland. A few areas are in permanent vegetation. This soil is poorly suited to farming. It has severe limitations for recreational and urban developments. Capability unit IVe-9 (4a); woodland suitability group E; recreation group 1.

Tawas Series

The Tawas series consists of very poorly drained, nearly level soils in bogs on outwash plains, in glacial drainageways, and on lake plains. These soils formed in organic materials, 12 to 42 inches thick, over sand. The native vegetation consisted mainly of elm, ash, soft maple, and aspen.

In a representative profile the upper 26 inches is black muck. Below this is a layer of very dark brown mucky peat about 5 inches thick. The underlying material, beginning at a depth of about 31 inches, is gray sand.

Permeability is moderately rapid in the organic material and rapid in the sand. The available water capacity is very high in the organic material and low in the sand. Fertility is low, especially in micronutrients. Surface runoff is very slow to ponded.

The suitability of Tawas soils for crops is variable, depending on the depth to sand. The soils are well suited to wetland wildlife habitat. Limitations for nonfarm uses are very severe. These soils are poorly suited to woodland.

Some areas of these soils are used for crops. The main crops are vegetables, corn, and commercial sod. Most areas remain in woodland or in pasture.

Representative profile of Tawas muck:

1—0 to 8 inches, black (10YR 2/1) muck; moderate; fine, granular structure; friable; common, partly decomposed, woody fragments; neutral.

2—8 to 26 inches, black (5YR 2/1) muck; weak, coarse, granular structure; friable; slightly acid; gradual, wavy boundary.

3—26 to 31 inches, very dark brown (10YR 2/2) mucky peat; massive; friable; common, partly decomposed, fibrous material; slightly acid.

IICg—31 to 60 inches, gray (5Y 5/1) sand; single grain; loose; mildly alkaline; slight effervescence.

The organic material is 12 to 42 inches thick over sandy material and is medium acid to neutral throughout. The 1 and 2 horizons are very dark brown (10YR 2/2) or black (10YR 2/1 or 5YR 2/1). The 3 horizon is dark reddish brown (5YR 2/2, 3/3, or 3/4) or very dark brown (10YR 2/2) and is mucky peat or muck. The lower part of the 3 horizon commonly contains more mineral material than organic material. The IICg horizon is grayish brown (10YR 5/2), light brownish gray (10YR 6/2), or gray (10YR 5/1). It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The average annual temperature of these soils is a few degrees warmer than is defined as the range for the series, and this difference alters the usefulness and behavior of these soils for many farm and nonfarm uses.

Tawas soils are similar to Carlisle, Edwards, Linwood, and Wallkill soils. These soils lack the organic material, 42 inches or more thick, that is in the Carlisle soils. They lack marl at a depth of 12 to 42 inches that is in the Edwards soils. Tawas soils have sandy material at a depth of 12 to 42 inches, rather than loamy material as in Linwood soils. They lack 10 to 40 inches of loamy material immediately above the organic material that is in the Wallkill soils.

Tawas muck (0 to 2 percent slopes) (Ta).—This soil is in depressions on uplands and in swales and flats on lowlands. The areas are small to medium in size and irregular in shape.

Included with this soil in mapping are small areas of the poorly drained Gilford or Sebewa soils. These soils are along margins or occur as slight rises in areas of Tawas soils. Also included are a few areas of the very poorly drained Edwards soils. Other inclusions are some very small, seepy areas where the slope is 6 to 12 percent.

This soil is very susceptible to soil blowing if the surface is exposed. Fertility is low, including micronutrients. The main concerns of management are removing excess water and control of soil blowing, but improving and maintaining fertility are also important, as well as preventing loss of the layers of organic material, which would expose the underlying sand.

Some areas of this soil are used for corn, vegetables, and commercial sod. Some areas remain wooded or are used for pasture. It has very severe limitations for recreational or urban developments. Capability unit IVw-5 (M/4c); woodland suitability group J; recreation group 7.

Tuscola Series

The Tuscola series consists of moderately well drained, gently sloping soils on lake plains and outwash plains. These soils formed in water-laid materials that consist of stratified silt loam, very fine sand, and fine sand. The native vegetation consisted mainly of beech, maple, oak, basswood, and elm.

In a representative profile the surface layer is dark grayish-brown loam about 8 inches thick. The subsurface layer is light yellowish-brown very fine sandy loam about 4 inches thick. The upper 8 inches of the subsoil is dark grayish-brown, firm heavy silt loam. The middle 4 inches is yellowish-brown, firm heavy silt loam mottled with pale brown. The lower 10 inches is light yellowish-brown, very friable very fine sandy loam mottled with grayish brown. The underlying material, beginning at a depth of 34 inches, is pale-brown, stratified silt loam, fine sand, and very fine sand mottled with gray.

Permeability is moderate, the available water capacity is high, and fertility is high. Surface runoff is slow to medium.

Tuscola soils are well suited to farming. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are slight to moderate. These soils are well suited to woodland.

Most areas of these soils are used for crops. A few areas remain in woodland.

Representative profile of Tuscola loam:

Ap—0 to 8 inches, dark grayish-brown (10YR 4/2) loam; moderate, medium, granular structure; friable; neutral; abrupt, smooth boundary.

A2—8 to 12 inches, light yellowish-brown (2.5Y 6/4) very fine sandy loam; weak, thin, platy structure; very friable; slightly acid; clear, wavy boundary.

B21t—12 to 20 inches, dark grayish-brown (10YR 4/2) heavy silt loam; weak, fine, subangular blocky structure; firm; brown (10YR 5/3) clay films on surfaces of vertical peds; slightly acid; clear, wavy boundary.

B22t—20 to 24 inches, yellowish-brown (10YR 5/6) heavy silt loam; few, fine, distinct, pale-brown (10YR 6/3) mottles; weak, medium, subangular blocky structure; firm; grayish-brown (10YR 5/2) clay films on surfaces of peds; neutral; abrupt, wavy boundary.

B3—24 to 34 inches, light yellowish-brown (10YR 6/4) very fine sandy loam; common, medium, distinct, grayish-brown (10YR 5/2) mottles; weak, fine, subangular blocky structure; very friable; mildly alkaline; abrupt, wavy boundary.

C—34 to 60 inches, pale-brown (10YR 6/3) stratified silt loam and fine and very fine sand; common, medium, distinct, gray (10YR 5/1) mottles; massive; friable; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is slightly acid to mildly alkaline throughout. The Ap horizon is dark gray (10YR 4/1) or dark grayish brown (10YR 4/2) and is 6 to 10 inches thick. The A2 horizon is pale brown (10YR 6/3) or light yellowish brown (2.5Y or 10YR 6/4) and is silt loam, very fine sandy loam, or fine sandy loam. The Bt horizon is heavy silt loam, loam, or heavy fine sandy loam. The B3 horizon contains thin strata of silt loam or very fine sand in a few places. The C horizon is grayish brown (10YR 5/2) or pale brown (10YR 6/3) and commonly contains thin strata of fine sand or loamy sand. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The solum, at depths between 24 and 30 inches, is thinner and the Bt horizon has more grayish color on the surfaces of peds than is defined as the range for the series, but these differences do not alter the usefulness and behavior of these soils.

Tuscola soils formed in the same kind of material as Colwood and Kibbie soils. These soils lack the dominantly gray or grayish matrix colors in the subhorizons that are in the Colwood soils, and they have a thinner or lighter colored A horizon than those soils. They are dominantly less grayish in the B horizon than Kibbie soils. Tuscola soils are similar to Kendallville, Miami, and Owosso soils. They lack coarse fragments in the profile that are in the Kendallville, Miami, and Owosso soils. They have stratified material in the C horizon that is lacking in those soils.

Tuscola loam, 2 to 6 percent slopes (TsB).—This soil is in undulating areas on plains. The areas are small to medium in size.

Included with this soil in mapping are small eroded areas, at higher elevations, that have a light yellowish-brown surface layer. Also included are a few areas where the slope is 6 to 12 percent. In a few included areas the surface layer is fine sandy loam or silt loam.

The hazard of erosion is slight to moderate. The main concern of management is controlling erosion. Removal of excess water in spring is a concern in some areas.

Most areas of this soil are used for crops. A few areas remain in woodland. This soil is well suited to farming if erosion is controlled. It has slight to moderate limitations for most recreational and urban developments. Capability unit IIe-2 (2.5a); woodland suitability group U; recreation group 2.

Wallkill Series

The Wallkill series consists of very poorly drained, nearly level soils in depressions on till plains and moraines. These soils formed in loamy material, 10 to 40 inches thick, over organic material.

In a representative profile the surface layer is very dark gray loam about 8 inches thick. The subsoil, about 12 inches thick, is olive-gray, firm light clay loam mottled with light olive brown. The underlying material, beginning at a depth of about 20 inches, is black muck.

Permeability is moderate in the subsoil and moderately rapid in the underlying material. The available water

capacity is high in the loamy material and very high in the underlying organic material. Fertility is high. Surface runoff is very slow to ponded.

Wallkill soils are poorly suited to farming because of excess wetness, a high water table, difficulty in implementing drainage, and lack of suitable outlets. They are well suited to wetland wildlife habitat. Limitations for most nonfarm uses are very severe. These soils are poorly suited to woodland.

Most areas of these soils are in permanent pasture. A few areas are used for crops.

Representative profile of Wallkill loam:

Ap—0 to 8 inches, very dark gray (10YR 3/1) loam; moderate, medium, granular structure; friable; slightly acid; abrupt, smooth boundary.

Bg—8 to 20 inches, olive-gray (5Y 5/2) light clay loam; common, medium, distinct, light olive-brown (2.5Y 5/6) mottles; weak, medium, subangular blocky structure; firm; neutral; abrupt, wavy boundary.

IIC—20 to 60 inches, black (10YR 2/1) muck; massive; friable; mildly alkaline.

The loamy mineral material ranges from 10 to 40 inches in thickness over the organic material, but it is dominantly 15 to 30 inches thick. The loamy material is slightly acid to moderately alkaline throughout. The Ap horizon is very dark brown (10YR 2/2), very dark gray (10YR 3/1), or black (10YR 2/1). The Bg horizon is gray (N 5/0 or 10YR 5/1), olive gray (5Y 5/2), or dark gray (10YR 4/1 or N 4/0). The IIC horizon is very dark brown (10YR 2/2), dark reddish brown (5YR 2/2, 3/2, 3/3, or 3/4), reddish brown (5YR 4/3, 4/4, or 5/4), very dark gray (10YR 3/1 or N 3/0), or black (10YR 2/1 or N 2/0).

The loamy material of these soils, less than 16 inches thick, is thinner than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Wallkill soils are similar to Carlisle, Colwood, Linwood, and Tawas soils. These soils have 10 to 40 inches of loamy material immediately above the organic material which is lacking in Carlisle, Linwood, and Tawas soils. They differ from the Colwood soils in lacking mineral material throughout at depths between 10 to 40 inches.

Wallkill loam (0 to 2 percent slopes) (Wa).—This soil is in swales and small depressions on uplands. The areas are small in size and irregular in shape. Included with this soil in mapping are small areas of the poorly drained Brookston soils.

This soil remains wet and water stands on the surface for long periods. The main concern of management is removing excess water, but obtaining suitable outlets is difficult.

Most areas of this soil are used for permanent pasture. A few areas are used for crops. This soil is poorly suited to farming unless excess water is removed. It has very severe limitations for most recreational and urban developments. Capability unit Vw-3 (L-2c); woodland suitability group J; recreation group 7.

Wasepi Series

The Wasepi series consists of somewhat poorly drained, nearly level to gently sloping soils on outwash plains, lake plains, stream terraces, and glacial drainageways. These soils formed in gravelly light sandy clay loam and sandy loam, 24 to 42 inches thick, over fine gravelly coarse sand. The native vegetation consisted mainly of oak, red maple, hickory, elm, and ash.

In a representative profile the surface layer is very dark grayish-brown sandy loam about 8 inches thick. The subsurface layer, about 10 inches thick, is grayish-brown light sandy loam mottled with yellowish brown. The upper 9 inches of the subsoil is grayish-brown, firm gravelly light sandy clay loam mottled with dark yellowish brown; the lower 6 inches is brown, friable sandy loam mottled with yellowish brown. The underlying material, beginning at a depth of about 33 inches, is light brownish-gray fine gravelly coarse sand.

Permeability is moderately rapid, the available water capacity is low, and fertility is medium. Surface runoff is slow.

Wasepi soils are moderately suited to farming if excess water is removed and soil fertility is maintained. They are well suited to openland wildlife habitat. Limitations for most nonfarm uses are moderate to severe. These soils are generally poorly suited to woodland.

Most areas of these soils are used for crops. A few areas are used for pasture or woodland.

Representative profile of a Wasepi sandy loam:

Ap—0 to 8 inches, very dark grayish-brown (10YR 3/2) sandy loam; moderate, fine, granular structure; friable; less than 5 percent gravel; neutral; abrupt, smooth boundary.

A2g—8 to 18 inches, grayish-brown (10YR 5/2) light sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, fine, subangular blocky structure; very friable; less than 5 percent gravel; neutral; clear, wavy boundary.

B21tg—18 to 27 inches, grayish-brown (10YR 5/2) gravelly light sandy clay loam; common, medium, distinct, dark yellowish-brown (10YR 4/4) mottles; weak, medium, subangular blocky structure; firm; clay films on surfaces of peds; 20 percent gravel; slightly acid; gradual, wavy boundary.

B22t—27 to 33 inches, brown (10YR 5/3) sandy loam; common, medium, distinct, yellowish-brown (10YR 5/8) mottles; weak, medium, subangular blocky structure; friable; clay bridges connect sand grains; 15 percent gravel; neutral; abrupt, irregular boundary.

IIC—33 to 60 inches, light brownish-gray (10YR 6/2) fine gravelly coarse sand; single grain; loose; 30 percent fine gravel; mildly alkaline; slight effervescence.

The solum ranges from 24 to 40 inches in thickness and is medium acid to neutral throughout. The Ap horizon is very dark brown (10YR 2/2), dark gray (10YR 3/1), or very dark grayish brown (10YR 3/2) and is 7 to 10 inches thick. The A2g horizon is brown (10YR 5/3), pale brown (10YR 6/3), or grayish brown (10YR 5/2). The B horizon is light clay loam, light sandy clay loam, or sandy loam; it is gravelly in places. The IIC horizon is sand or coarse sand; it is gravelly or very gravelly in places. It is mildly alkaline or moderately alkaline and has slight effervescence or strong effervescence.

The matrix color of these soils in part of the B horizon is less brownish than is defined as the range for the series, but this difference does not alter the usefulness and behavior of these soils.

Wasepi soils formed in the same kind of material as Boyer and Gilford soils. These soils have mottles in the solum, which are lacking in Boyer soils, and they have a thicker or darker colored A horizon than those soils. They have a thinner A horizon than Gilford soils. These soils have drainage similar to Locke, Macomb, and Matherton soils. They have a coarser texture in the C horizon and average a higher content of coarse fragments in the C horizon than Locke and Macomb soils. They average a lower content of clay in the Bt horizon than Macomb and Matherton soils.

Wasepi sandy loam, 0 to 2 percent slopes (WeA).—This soil is on lowlands. The areas are small to medium in size

and irregular in shape. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of Gilford soils in depressions and narrow drainageways (fig. 9). Also included are small areas of somewhat poorly drained Matherton soils.

The main concern of management is removal of excess water and maintaining fertility.

Most areas of this soil are used for crops. A few areas are used for pasture or woodland. This soil is moderately suited to farming if excess water is removed and soil fertility is maintained. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIw-5 (4b); woodland suitability group G; recreation group 3.

Wasepi sandy loam, 2 to 6 percent slopes (WeB).—This soil is on knolls and low mounds on lowlands. The areas are small to medium in size and irregular in shape. Slopes are less than 100 feet long.

Included with this soil in mapping are small areas of poorly drained Gilford soils in depressions and narrow drainageways. Also included are a few areas where cobblestones and gravel are on the surface, but these do not interfere with tillage.

The main concern of management is removal of excess water and maintaining fertility.

Most areas of this soil are used for crops. A few areas are in woodland or are used for pasture. This soil is moderately suited to farming if excess water is removed and fertility is maintained. It has moderate to severe limitations for recreational and urban developments. Capability unit IIIw-5 (4b); woodland suitability group G; recreation group 3.

Use and Management of the Soils

This section begins with an explanation of the system of capability grouping used in the Soil Conservation Service to classify soils according to their relative suitability for general field crops. Following this explanation are discussions of the use and management of the soils of Shiawassee County, as grouped according to this system. Next is a table that shows predicted yields of the principal crops grown in the county, by individual soils. This is followed by discussions of the use and management of the soils as woodland; for this purpose, the soils are grouped on the basis of similarity in productivity and management needs. Next is a discussion of the elements of wildlife habitat and a table that shows, by series, the relative suitability of the soils for management as wildlife habitat. Following this is a discussion of properties that affect the use of soils as locations for recreational facilities; for this purpose the soils are grouped according to their relative degree of limitation for such use. The last part of the section concerns soils in connection with engineering; it consists mainly of tables that give descriptions of soil properties significant in engineerng and interpretations of these properties as they affect the suitability of the soils for specified engineering uses.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expen-

Figure 9.—**Light-colored Wasepi soils and included areas of dark-colored Gilford soils. Excessive wetness of Gilford soils delays planting in some years.**

sive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups for range, for forest trees, or engineering.

In the capability system, all kinds of soils are grouped at three levels: the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

Class I soils have few limitations that restrict their use. (There are no class I soils in Shiawassee County.)

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, woodland, or wildlife.

Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes.

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-3 or IIIe-6. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

The capability classification of each soil in Shiawassee County is given in the "Guide to Mapping Units" at the end of this publication. For a complete explanation of the capability classification system, see Agriculture Handbook No. 210, "Land-Capability Classification" (*6*).[1]

Management by Capability Units[2]

In the following pages the capability units in Shiawassee County are described, and suggestions for the use and management of the soils in each unit are given. The Arabic numerals used in the unit symbols are not consecutive, because not all the capability units established in Michigan are represented in Shiawassee County.

Another symbol, made up of Arabic numerals and small or capital letters, is in parentheses following the symbol of each capability unit. This symbol identifies the Michigan management group or groups in which the soils of the capability unit have been placed. The management groups are part of a statewide system used in Michigan for making recommendations about applications of lime and fertilizer, about drainage, and about other practices. For an explanation of this classification, refer to "Fertilizer Recommendations for Michigan Vegetable and Field Crops" (*3*).

Certain practices basic to good soil management can be mentioned before discussing the individual capability units. An adequate supply of plant nutrients and organic matter, a good root zone, and the proper balance of air and water are necessary to grow crops efficiently. Management practices needed to improve yields include drainage, control of erosion, rotation of crops, use of suitable crop varieties, and the adequate use of lime and fertilizer. Lime and fertilizer should be applied according to soil tests and the needs of the crops.

Many of the soils in Shiawassee County need artificial drainage. Drainage of soils improves the air-water relationship in the root zone. Tile drains or surface drainageways, or both, can be used to remove excess water, but they should be designed to function properly. Suitable outlets are difficult to find in some areas. Good soil structure and an ample supply of organic matter also are

[1] Italic numbers in parentheses refer to Literature Cited, p. 111.

[2] RICHARD H. DRULLINGER, agronomist, Soil Conservation Service, helped prepare this section.

beneficial to drainage. Low-lying areas are subject to a shortened growing season because of frosts late in spring and early in fall.

The loss of the surface layer through erosion reduces soil productivity. Erosion generally can be controlled by reducing the rate and volume of runoff and by increasing the rate of water absorption by the soil. Growing meadow crops, cover crops, or green-manure crops and using crop residue properly help to reduce surface runoff. Contour cultivation, stripcropping, grassed waterways, windbreaks, minimum tillage, and the use of diversions and terraces and other measures are effective in controlling erosion.

Practices to maintain and improve the organic-matter content and tilth include the growing of cover crops, stubble mulching, minimum tillage, the growing of green-manure crops, and the application of barnyard manure. Loamy soils should not be grazed when wet because grazing results in compaction of the soils and poor tilth. These practices are needed most if rotation is intensive or if cultivation is continuous.

Additional help in managing the soils can be obtained by consulting the local representative of the Soil Conservation Service or the Cooperative Extension Service.

The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series are in the unit. To find the capability classification of any given soil, refer to the "Guide to Mapping Units" at the end of this publication.

CAPABILITY UNIT IIe-2 (2.5a, 3/2a)

This unit consists of moderately well drained and well drained, gently sloping or undulating soils of the Celina, Kendallville, Miami, and Tuscola series. These soils have a surface layer of loam or sandy loam and a subsoil of sandy loam to clay loam. Some areas of these soils are moderately eroded.

Permeability is moderate or moderately slow. Available water capacity is high and surface runoff is slow to medium. Fertility is high.

Susceptibility to water erosion is the main limitation for farming. In spring excess water needs to be removed from the Celina and Tuscola soils. Small seep areas and wet areas in depressions hinder planting and harvesting in wet periods. Applying manure to moderately eroded areas improves tilth, promotes germination of seed, and improves yields.

The soils of this unit are well suited to row crops, small grain, hay, and pasture plants.

CAPABILITY UNIT IIe-3 (2.5a, 3a, 3/2a)

This unit consists of moderately well drained and well drained, gently sloping soils of the Fox, Lapeer, Miami, Newaygo, and Owosso series. These soils have a surface layer of sandy loam and a subsoil of sandy loam to clay loam. (The Miami soils in this unit are those in Owosso-Miami sandy loams, 2 to 6 percent slopes.)

Permeability is moderate or moderately rapid. Fox and Newaygo soils have rapid permeability in the underlying material, which is gravelly coarse sand. Owosso soils have moderately slow permeability in the loamy underlying material. Available water capacity is moderate, and surface runoff is slow to medium. Fertility is medium.

Susceptibility to water erosion and a shortage of soil moisture are the main limitations for farming. Moisture generally is not adequate for optimum crop growth during dry periods in summer. Crusting of the surface layer is seldom a concern of management, especially if minimum tillage is used and organic matter is plowed under.

The soils of this unit are well suited to row crops, small grain, and pasture plants.

CAPABILITY UNIT IIw-4 (1.5c, 2.5b, 2.5c, 3/2b, 3/2c)

This unit consists of poorly drained or somewhat poorly drained, nearly level soils of the Berville, Brookston, Conover, Lenawee, and Macomb series. These soils have a surface layer of loam and a subsoil of gravelly sandy clay loam to heavy clay loam. Also in this unit is Lenawee silt loam, which is heavy silty clay loam in most of the subsoil.

Permeability is moderately slow. Available water capacity is high. Surface runoff is slow to ponded. These soils are excessively wet in spring and after rain because of a fluctuating high water table. Fertility is high.

Excessive wetness is the main limitation for farming. The Lenawee soils puddle and dry out cloddy and hard if tilled when wet. Tilth is a concern of management in Lenawee soils. Drainage is provided by a combination of tile drains and open ditches. This soil material is stable and tile trenches and open ditches seldom cave in.

The soils of this unit are well suited to row crops, small grain, and pasture plants if the soils are drained. Selection of forage crops depends on wetness or the degree of drainage.

CAPABILITY UNIT IIw-5 (2/5b, 3/2b)

This unit consists of somewhat poorly drained, gently sloping or gently undulating soils of the Conover and Macomb series. These soils have a surface layer of loam or sandy loam and a subsoil of clay loam or gravelly clay loam.

Permeability is moderately slow. Available water capacity is high, and surface runoff is slow to medium. Water ponds in some areas in depressions and commonly delays planting and tillage of crops.

Excessive wetness and susceptiblity to water erosion are the main limitations to farming. In some areas of more sloping soils the layout and installation of drainage is difficult or impractical. Random tile drains provide drainage in places.

These soils are well suited to row crops, small grain, and pasture plants if drained.

CAPABILITY UNIT IIw-6 (2.5b, 2.5c, 3b, 3c, 3/Rc)

This unit consists of poorly drained or somewhat poorly drained, nearly level soils of the Barry, Colwood, Kibbie, Locke, Matherton, Richter, and Sebewa series. These soils have a surface layer of loamy fine sand, sandy loam, stony sandy loam, or loam and a subsoil of loamy sand to clay loam. Barry sandy loam, bedrock variant, have sandstone bedrock at a depth of 24 to 40 inches.

Permeability is moderate to moderately rapid. The Matherton and Sebewa soils have very rapid permeability in the underlying very gravelly coarse sand. Available water capacity is moderate to high. Fertility is medium to high. Surface runoff is slow to ponded. They are ex-

cessively wet in spring and after rain because of a fluctuating high water table.

Excessive wetness is the main limitation for farming. Installing tile drains is difficult in areas of Kibbie and Colwood soils because the silty and sandy material caves into the tile trenches readily. Backfilling of the trenches helps to prevent the sandy and silty material from flowing into and plugging tile drains. Sebewa, Matherton, Kibbie, and Colwood soils are especially unstable when wet. Artificial drainage is difficult to establish in the bedrock variant of the Barry soil, because sandstone bedrock is at the depth at which tile drains are commonly placed.

Drained areas of these soils are well suited or moderately well suited to row crops, small grain, and pasture plants. Barry stony loam soil is not so well suited to crops as Barry sandy loam, bedrock variant, because of stones on the surface and in the surface layer. Selection of forage crops depends on wetness or the degree of drainage.

CAPABILITY UNIT IIw–7 (2.5b, 3b)

This unit consists of somewhat poorly drained, gently sloping soils of the Kibbie, Locke, and Matherton series. These soils have a surface layer of sandy loam or loam and a subsoil of heavy fine sandy loam to gravelly clay loam.

Permeability is moderate. Matherton soils have very rapid permeability in the underlying material, which is very gravelly coarse sand. Available water capacity is moderate to high, and surface runoff is slow. Fertility is medium to high.

Excessive wetness and susceptibility to water erosion are the main limitations for farming. A complete drainage system is difficult to install in some areas of these gently sloping soils. Random tile and surface drains provide drainage in many areas if adequate outlets are available. Installing tile drains is difficult in areas of Kibbie soils because they are especially unstable when wet and the silty and sandy material caves into the trenches readily. Backfilling of trenches helps to prevent the sandy and silty material from flowing into and plugging tile drains.

These soils are well suited to row crops, small grain, and pasture plants if drained.

CAPABILITY UNIT IIw–8 (3/2b, 3/2c)

This unit consists of poorly drained and somewhat poorly drained, nearly level or gently sloping soils of the Belding, Breckenridge, Matherton, and Metamora series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of sandy loam to clay loam. The Matherton soils in this unit are underlain by loamy material at a depth of 42 to 66 inches.

Permeability is moderately rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Permeability is moderate in the Matherton soil. Available water capacity is moderate and surface runoff is slow to ponded. These soils are excessively wet in spring and after rains because of a fluctuating water table. Fertility is medium to high.

Excessive wetness is the main limitation for farming. Areas of sloping soils are generally more difficult to drain than level areas. Random tile and surface drains are used to remove excessive water at higher elevations.

If drained, these soils are well suited to row crops, small grain, and pasture plants.

CAPABILITY UNIT IIw–10 (M/3c)

This unit consists of Linwood muck, a very poorly drained, nearly level soil. This soil has a surface layer and underlying material of muck, 12 to 42 inches deep, over loamy material.

Permeability is moderately rapid in the muck and moderate in the loamy underlying material. Available water capacity is very high in the muck and moderate in the loamy material. Surface runoff is very slow or ponded. Fertility is low.

Excessive wetness, susceptibility to soil blowing, low fertility (including a shortage of micronutrients), and a frost hazard are the main limitations for farming. Severe damage can result from wind action, which removes newly seeded crops as well as soil material. Excess water can be removed by means of tile drains or open ditches. Controlling the water table to maintain a favorable moisture content helps to keep the organic surface layer from settling.

This soil is well suited to truck crops, vegetable crops, and general field crops if drainage is improved, soil blowing controlled, and adequate fertilizer is used.

CAPABILITY UNIT IIIe–5 (2.5a, 3/2a)

This unit consists of well-drained, sloping or rolling soils of the Kendallville and Miami series. These soils have a surface layer of sandy loam or loam and a subsoil of sandy clay loam, gravelly clay loam, or clay loam. Some areas of these soils are moderately eroded.

Permeability is moderate to moderately slow. Available water capacity is high, and surface runoff is medium. Runoff is more rapid in eroded areas than in uneroded areas, and less water moves into the soil to be used by plants. Fertility is high.

Susceptibility to severe water erosion and loss of soil moisture because of runoff are the main limitations for farming. Moderately eroded areas have poor tilth and crust readily on drying. Crusting of the surface layer is a serious concern of management on the eroded soils. This crusting results in uneven stands of plants and reduces yields.

These soils are moderately well suited to row crops and small grain if protected from erosion. They are well suited to forage crops. A cropping system that includes a large proportion of close-growing crops helps to control runoff and erosion.

CAPABILITY UNIT IIIe–6 (2.5a, 3a, 3/2a)

This unit consists of well-drained, sloping or rolling soils of the Fox, Lapeer, Miami, and Owosso series. These soils have a surface layer of sandy loam and a subsoil of sandy loam to clay loam. (The Miami soils in this unit are those in Owosso-Miami sandy loams, 6 to 12 percent slopes.) Some areas are moderately eroded.

Permeability is moderate to moderately rapid. Fox soils have rapid permeability in the underlying material, which is gravelly coarse sand. Owosso soils have moderately slow permeability in the loamy underlying material. Available water capacity is moderate and surface runoff is medium. Fertility is medium. Miami soils have high available water capacity and high fertility. In the moderately eroded soils, erosion has impaired fertility, reduced organic-matter content, increased runoff, and reduced yields.

Susceptibility to severe water erosion and a shortage of moisture for plants during dry months in summer are the main limitations for farming.

These soils are moderately well suited to row crops and small grain if erosion is controlled and moisture is conserved. They are well suited to forage crops. A cropping system that includes a large proportion of close-growing crops helps to control runoff and erosion.

CAPABILITY UNIT IIIe-9 (4a, 4/2a)

This unit consists of well-drained, sloping or rolling soils of the Boyer, Menominee, and Spinks series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of loamy sand, sandy loam, or gravelly sandy clay loam.

Permeability is moderately rapid to rapid. Menominee soils have moderately slow permeability in the loamy underlying material. Available water capacity is moderate to low, and surface runoff is slow to medium. Fertility generally is low, but it is medium in Boyer sandy loam.

Susceptibility to water erosion, low available water capacity, and low fertility are the main limitations for farming. Soil blowing is a concern of management in large cultivated areas. The low available water capacity prevents shallow-rooted crops from attaining optimum growth. Small grain normally mature early, while the moisture supply is still adequate. These soils warm up early in spring and are ready for planting sooner than the more loamy soils.

These soils are moderately well suited to row crops, small grain, and pasture plants.

CAPABILITY UNIT IIIw-5 (4b)

This unit consists of somewhat poorly drained, nearly level or gently sloping soils of the Gladwin and Wasepi series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of loamy sand, sandy loam, or gravelly light sandy clay loam.

Permeability is moderately rapid. Available water capacity is low, and surface runoff is slow. Fertility is low to medium.

Excessive wetness, low available water capacity, and susceptibility to soil blowing are the main limitations for farming. If drained, these soils tend to be droughty during the dry months in summer. Tile drains are more easily placed during dry periods because the sandy material readily caves into tile trenches and ditches if the soils are wet. The low available water capacity prevents shallow-rooted crops from attaining optimum growth. Small grain normally mature early, while the moisture supply is still adequate. These soils warm up early in spring and are ready for planting sooner than the more loamy soils.

These soils are moderately well suited to row crops, small grain, and pasture plants. Gladwin soils are not so well suited to farming as Wasepi soils, because they are low in fertility and are more susceptible to soil blowing.

CAPABILITY UNIT IIIw-6 (4c, 5c)

This unit consists of poorly drained, nearly level soils of the Gilford and Granby series. The Gilford soils have a surface layer of sandy loam and a subsoil of fine sandy loam; the Granby soils have a surface layer of loamy sand and a subsoil of sand.

Permeability is moderately rapid or rapid. Available water capacity is low, and surface runoff is very slow or ponded. Fertility is low or medium.

Excessive wetness, low soil moisture, and susceptibility to soil blowing are the main limitations for farming. Tile drains are more easily placed during dry periods because ditchbanks and tile trenches cave in readily when the soils are wet. Controlling drainage helps to regulate the amount of moisture available to plants.

These soils are moderately suited to row crops, small grain, and pasture plants. Granby soils are not so well suited to farming as Gilford soils, because they are low in fertility and lack sufficient moisture in summer.

CAPABILITY UNIT IIIw-9 (4/2b, 4/2c)

This unit consists of poorly drained to somewhat poorly drained, nearly level soils of the Brevort and Iosco series, and Iosco loamy sand, deep variant. These soils have a surface layer of loamy sand and a subsoil of sand to clay loam.

Permeability is rapid in the upper part of the subsoil and moderately slow in the lower part of the subsoil and in the underlying material. Available water capacity is moderate, and surface runoff is slow to ponded. Fertility is low.

Excessive wetness, low soil moisture, and susceptibility to soil blowing are the main limitations for farming. These soils dry out quickly and support farm machinery if the water table is lowered by drainage. Tile drains and ditches are more easily placed during dry periods because ditchbanks and tile trenches cave in readily when the soils are wet. Small grain normally mature early, while the moisture supply is still adequate.

If drained, these soils are moderately suited to row crops, small grain, and pasture plants.

CAPABILITY UNIT IIIw-15 (Mc)

This unit consists of Carlisle muck, a very poorly drained, nearly level soil. It has a surface layer of muck and underlying material of muck and mucky peat.

Permeability is moderately rapid. Available water capacity is very high and surface runoff is very slow or ponded. Fertility is low.

Excessive wetness, susceptibility to soil blowing, low fertility (including a shortage of micronutrients), and fire and frost hazards are the main limitations for farming. Artificial drainage is needed if this soil is cultivated intensively. Severe damage can result from wind action, which removes newly seeded crops as well as soil material (fig. 10). Sprinkler irrigation is commonly used on this soil to increase yields, decrease soil blowing, aid the growth of young transplants, and provide protection from frost damage. Selecting frost-hardy plants, providing good air drainage, and heavy applications of fertilizer reduce the hazard of frost damage. Controlling the water table to maintain a favorable moisture content helps to keep the organic surface layer from settling.

If excess water is removed and the soil is carefully managed, vegetables and some general crops are well suited.

CAPABILITY UNIT IIIs-4 (4a, 4/2a, 5a)

This unit consists of moderately well drained and well drained, nearly level or gently sloping soils of the Boyer.

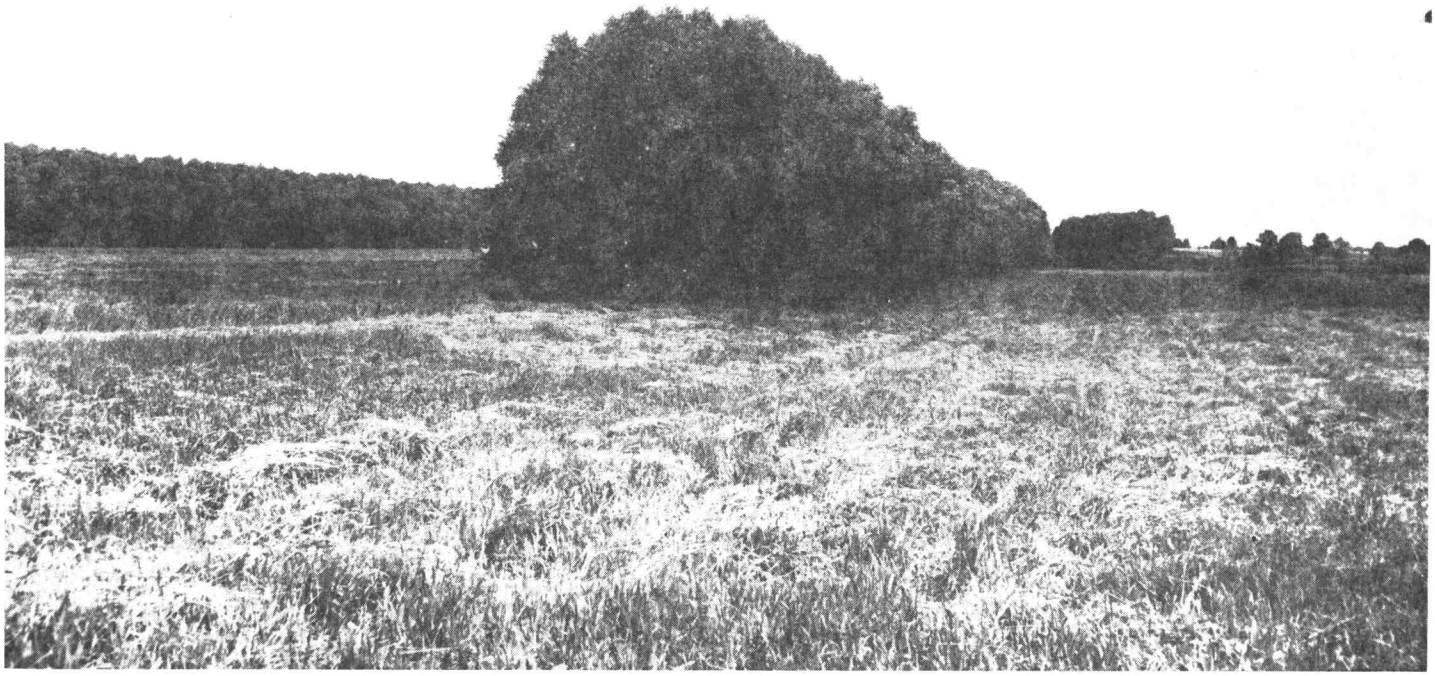

Figure 10.—Windbreak in an area of Carlisle soils.

Mancelona, Menominee, Ottokee, and Spinks series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of sand to gravelly sandy clay loam.

Permeability is moderately rapid to rapid. Available water capacity is low and surface runoff is slow. Fertility generally is low. Menominee soils have moderately slow permeability and moderate available water capacity in the underlying loamy material.

Low available water capacity, low fertility, and susceptibility to soil blowing are the main limitations for farming. Water erosion is seldom a concern of management. Crops lack sufficient moisture during dry periods, and crop yields are reduced. Small grain normally mature early, while the moisture supply is still adequate. These soils warm up and are ready for planting early in spring. Excessive tillage causes a greater hazard of soil blowing.

These soils are moderately well suited to row crops, small grain, and pasture plants if moisture is conserved and fertility is maintained. Boyer sandy loam is more fertile and less susceptible to soil blowing than the other soils.

CAPABILITY UNIT IVe–4 (2.5a, 3a, 3/2a)

This unit consists of well-drained, moderately steep or hilly soils of the Fox, Miami, and Owosso series. These soils have a surface layer of sandy loam or loam and a subsoil of sandy loam to clay loam. Most of these soils are moderately eroded.

Permeability is moderate to moderately rapid. Owosso soils have moderately slow permeability in the underlying loamy material. Available water capacity is moderate to high and surface runoff is rapid. Fertility is medium to high.

The slope and susceptibility to water erosion are the main limitations for farming. Water runs off these moderately steep soils rapidly in cultivated areas and erosion is a serious concern of management. The organic-matter content is low and the surface layer tends to crust in the eroded areas. Crop yields are lower during dry seasons because water runs off and little water is stored in the soil for use by plants. Slopes are generally too complex and too short for stripcropping.

These soils are poorly suited to row crops but moderately well suited to small grain, hay, and pasture plants.

CAPABILITY UNIT IVe–9 (4a)

This unit consists of well-drained, moderately steep or hilly soils of the Boyer and Spinks series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of sand to gravelly sandy clay loam.

Permeability is moderately rapid. Available water capacity is low and surface runoff is medium or rapid. Fertility generally is low.

Susceptibility to water erosion, low soil moisture, and low fertility are the main limitations for farming. Soil blowing is a concern of management in large cultivated areas. Maintaining a grass cover helps to control erosion, but gullies form in overgrazed areas. Small grain normally mature early, while soil moisture is still adequate. Heavy additions of fertilizer are not generally profitable or beneficial during dry periods, because soil moisture is inadequate for the crop to mature.

These soils are poorly suited to row crops but moderately well suited to small grain, hay and pasture plants.

CAPABILITY UNIT IVw–5 (M/4c)

This unit consists of Tawas muck, a very poorly drained, nearly level soil. This soil has a surface layer of muck and underlying material of muck and mucky peat, 12 to 42 inches thick, over sandy material.

Permeability is moderately rapid in the organic material and rapid in the sand. Available water capacity is very high in the muck and low in the sandy underlying material. Surface runoff is very slow or ponded. Fertility is low.

Excessive wetness, susceptibility to soil blowing, low fertility (including a shortage of micronutrients), and fire and frost hazards are the main limitations for farming. In some areas the shallow depth to sand is an additional limitation. Artificial drainage is generally needed if crops are grown. Severe damage can result from wind action, which removes newly seeded crops as well as soil material, and damages growing crops. Controlling the water table to maintain a favorable moisture content helps to keep the organic surface layer from settling and to maintain optimum yields.

The suitability of Tawas muck for crops depends on the depth to sand, the difficulty of drainage, and the danger of frost. These factors need to be studied before row crops are planted. This soil is moderately well suited to some forage crops.

CAPABILITY UNIT IVw-6 (M/mc)

This unit consists of Edwards muck, a very poorly drained, nearly level soil. This soil has a surface layer and underlying material of muck, 12 to 42 inches thick, over marl (fig. 11). Included are a few areas where the depth to marl is less than 12 inches.

Permeability is moderately rapid in the organic material but variable in the marl. Available water capacity is very high, and surface runoff is very slow or ponded. Fertility is low.

Excessive wetness, susceptibility to soil blowing, low fertility, and the shallowness to marl are the main limitations for farming. Drainage is not practical nor even possible in some areas, because of marl and a lack of drainage outlets. The presence of marl also causes some nutrient deficiencies.

The suitability of this soil for crops depends on the depth to marl, the difficulty of drainage, and the danger of frost. Before any effort is made to grow crops, these factors should be studied and the reaction of the soil determined. Suitable forage crops are moderately well suited.

CAPABILITY UNIT Vw-1 (3c, 4/2b)

This unit consists of poorly drained and somewhat poorly drained, nearly level soils of the Gilford and Iosco series. These soils have a surface layer of stony loamy sand or stony sandy loam and a subsoil of sand to clay loam. Few to many cobblestones, 3 to 6 inches in diameter, are in the upper part of the subsoil in many areas.

Permeability is moderate to rapid. The Iosco soils have moderately slow permeability in the underlying loamy material. Available water capacity is low or moderate, and surface runoff is slow to ponded. Fertility is low or medium.

Wetness and the stony surface layer are the main limitations for farming. Most areas of these soils are too wet and too stony for cultivation. The soils are also too stony to install tile drains for removal of excess water. These

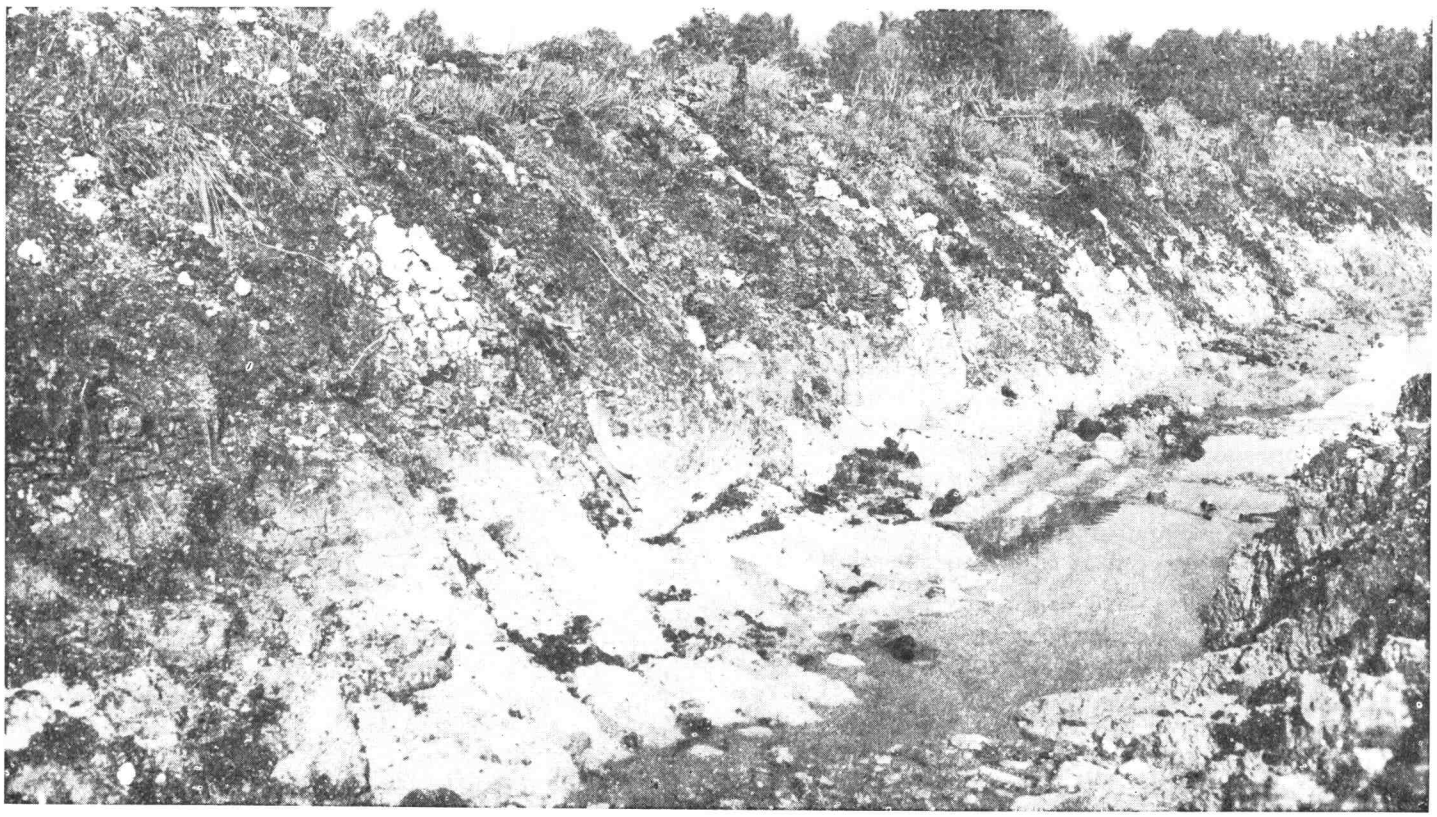

Figure 11.—This freshly dug ditch shows that the depth to white marl varies sharply in Edwards muck.

soils are generally in permanent pasture if farmed. A few areas are in woodland.

These soils are very poorly suited to row crops and small grain but moderately well suited to hay and pasture plants.

CAPABILITY UNIT Vw-3 (L-2a, L-2c, L-4a)

This unit consists of poorly drained to moderately well drained, nearly level soils of the Abscota, Ceresco, Cohoctah, Eel, Landes, Shoals, Sloan, and Wallkill series. These soils have a surface layer of loam and a subsoil of sandy loam to light clay loam. Wallkill soils are underlain by muck at a depth of 10 to 40 inches. Landes and Abscota soils have a surface layer of sandy loam and a subsoil of sand, loamy sand, and sandy loam.

Permeability is moderate to moderately rapid. Available water capacity is moderate to high. Surface runoff is slow to ponded. Fertility is medium to high. Abscota soils have rapid permeability, low available water capacity, and low fertility.

Excessive wetness, the flood hazard, and the frost hazard are the main limitations for farming. Many areas are small in size because of meandering streams and are impractical to farm. The dominant plants are reed canarygrass and native grasses.

Some areas of these soils are suited to pasture if they are dry and not flooded.

CAPABILITY UNIT VIe-2 (2.5a, 4a)

This unit consists mainly of well-drained, steep soils of the Boyer and Miami series. These soils have a surface layer of loamy sand or loam and a subsoil of sandy loam to clay loam. Boyer very stony loamy sand is gently sloping and has stones, 10 to 20 inches in diameter, in the surface layer and many cobblestones, 3 to 6 inches in diameter, in the subsoil. Miami clay loam is severely eroded and has a clay loam surface layer.

Permeability is moderate in Miami soils and moderately rapid in Boyer soils. Available water capacity is high in Miami soils and low in Boyer soils. Surface runoff is rapid, except for the Boyer very stony loamy sand, which has slow surface runoff. Fertility is high in Miami soils and low in Boyer soils.

The slope, stoniness, and susceptibility to water erosion are the main limitations for farming. The very stony Boyer soil is too stony for cultivation or for hay crops. The Miami clay loam becomes cloddy and hard if tilled when wet. The major soils in this unit erode easily if intensively cultivated. Maintaining a vegetative cover helps to control erosion. Overgrazing of pastures results in gullies or sheet erosion in places. Steepness hinders the use of farm machinery and, therefore, interferes with planting and harvesting operations.

These soils are better suited to hay and pasture plants than to other uses.

CAPABILITY UNIT VIs-1 (5a)

This unit consists of well-drained, gently sloping to rolling soils of the Plainfield series, slightly acid variant. These soils have a surface layer of loamy sand and a subsoil of sand.

Permeability is rapid. Available water capacity is low, and surface runoff is slow. Fertility is low. The soils dry out quickly and are deficient in moisture during dry months in summer.

Low soil moisture, susceptibility to soil blowing, and low fertility are the main limitations for farming. Crops that mature early can be grown if a large amount of organic material is added to the soils. Pasture and forage plants grow well in the early part of the growing season, but they dry out as soil moisture is depleted during the dry months in summer. Maintaining a protective cover of vegetation reduces the hazard of erosion. Overgrazing results in blowouts or other severe erosion. Planting of trees helps to control erosion and provides wildlife habitat.

These soils are poorly to very poorly suited to farming.

CAPABILITY UNIT VIIw-1 (L-4c)

This unit consists of somewhat poorly drained or poorly drained, nearly level soils of the Algansee and Glendora series. These soils have a surface layer of sandy loam and a subsoil or underlying material of loamy sand or sand.

Permeability is rapid. Available water capacity is low, and surface runoff is slow to ponded. Fertility is low.

Excessive moisture, the flood hazard, low available water capacity, and low fertility are the main limitations for farming. Many areas are small in size because of meandering streams and are impractical to farm. Water-tolerant forage crops are suitable in undrained areas. Minimum tillage should be used. The hazard of frost damage is severe because these soils are in low-lying areas.

These soils are poorly suited to very poorly suited to farming. Some areas are suited to pasture if dry and are not frequently flooded.

CAPABILITY UNIT VIIIs-1 (8a)

This unit consists of Gravel pits, Made land, and Mine pits.

Gravel pits consist of land from which the soil layers have been removed or pushed aside and the gravelly sand or sand used for roadbuilding, concrete materials, or various other uses. Some pits contain water and have potential for recreational uses or as a limited source of water.

Made land consists of areas that have been covered by fill material of variable composition or that have been scraped off to such a depth that the natural soil characteristics have been destroyed. Most of these areas are in commercial or residential uses.

Mine pits consist of land from which the soil layers and underlying material have been removed during shale or coal mining operations. These pits ordinarily have no use other than as a source of coal or shale. Abandoned pits provide a limited use as wildlife refuge.

These miscellaneous land types generally are not suitable for farming.

Predicted Yields

Table 2 shows the predicted average yields per acre of the principal crops grown in Shiawassee County under prevailing management and under improved management. These predictions are indicative of the relative productivity of the soils of the county.

TABLE 2.—*Predicted average yields under two levels of management*

[Columns A show yields to be expected under management common in the county; columns B show yields that can be obtained under improved management. Dashes indicate that the soil is not suited to the crop or that the crop is not ordinarily grown on it]

Soil	Corn				Oats		Wheat		Alfalfa-brome hay		Mixed hay		Field beans and soybeans	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*
Algansee sandy loam	55	95	11	17	50	85	25	45	2.1	4.0	1.7	2.5	17	35
Barry loam	50	80	10	16	48	80	25	40	2.1	3.8	1.7	2.5	17	35
Barry sandy loam, bedrock variant					45	75	25	38	2.0	3.5	1.7	2.2		
Barry stony loam	50	95	10	17	40	85	30	45	2.3	4.0	1.2	2.6	18	38
Belding sandy loam, 0 to 2 percent slopes	60	115	12	19	45	95	25	50	2.0	4.5	1.7	2.8	15	42
Berville loam	35	65	7	13	30	55	23	33	1.7	3.0	1.0	2.0	12	23
Boyer loamy sand, 0 to 2 percent slopes	30	63	6	12	28	53	20	30	1.7	2.9	1.0	2.0	10	23
Boyer loamy sand, 2 to 6 percent slopes	25	55	5	11	22	40	17	25	1.6	2.8	1.0	1.6		
Boyer loamy sand, 6 to 12 percent slopes					18	35	12	20	1.3	2.7	.8	1.4		
Boyer loamy sand, 12 to 18 percent slopes									1.1	2.3	.6	1.3		
Boyer loamy sand, 18 to 25 percent slopes														
Boyer very stony loamy sand, 2 to 6 percent slopes														
Boyer sandy loam, 0 to 2 percent slopes	45	75	9	15	34	65	25	36	1.9	3.4	1.4	2.2	18	28
Boyer sandy loam, 2 to 6 percent slopes	40	73	8	14	30	62	22	35	1.9	3.2	1.4	2.2	15	28
Boyer sandy loam, 6 to 12 percent slopes	38	60	8	12	25	50	20	32	1.8	2.9	1.3	1.9		
Boyer sandy loam, 12 to 18 percent slopes					18	35	15	26	1.5	2.7	1.0	1.6		
Breckenridge sandy loam	55	110	11	18	50	95	25	50	2.1	4.0	1.7	2.5	17	40
Brevort loamy sand	40	90	8	18	35	80	22	43	1.6	3.8	1.0	2.4	12	30
Brookston loam	60	125	12	21	50	98	25	55	2.1	5.0	1.7	2.8	17	44
Carlisle muck	40	115	8	19						4.2	1.6	2.3	25	40
Celina loam, 2 to 6 percent slopes	52	105	10	19	45	90	32	52	2.4	4.5	1.5	2.4	22	35
Celina loam, 2 to 6 percent slopes, moderately eroded	47	100	9	18	40	85	28	50	2.2	4.0	1.2	2.4	15	30
Ceresco loam														
Cohoctah loam														
Colwood loam	55	98	11	18	40	88	25	48	2.1	4.2	1.7	2.7	17	37
Conover loam, 0 to 2 percent slopes	60	118	12	19	55	95	32	55	2.6	4.5	2.1	2.5	23	40
Conover loam, 2 to 6 percent slopes	55	118	11	19	45	95	27	55	2.6	4.5	2.1	2.5	20	40
Edwards muck	30	80	6	16						3.4	1.6	2.3		
Eel, Landes, and Abscota soils									2.4	3.5	1.4	2.4		
Fox sandy loam, 2 to 6 percent slopes	45	95	9	17	45	82	30	46	2.5	4.0	1.6	2.4	18	30
Fox sandy loam, 6 to 12 percent slopes	40	85	8	17	40	70	30	40	2.3	3.7	1.5	2.3		
Fox sandy loam, 12 to 18 percent slopes					27	55	25	30	1.9	3.2	1.3	2.2		
Gilford sandy loam	40	88	8	17	30	70	15	42	1.6	3.7	1.0	1.8	15	32
Gilford stony sandy loam														
Gladwin loamy sand, 0 to 2 percent slopes	37	70	7	14	35	75	23	35	2.0	3.3	1.0	2.0	15	28
Glendora sandy loam														
Granby loamy sand	32	68	6	14	30	60	18	32	1.5	3.2	1.0	1.7	12	23
Gravel pits														
Iosco loamy sand, 0 to 2 percent slopes	42	90	8	17	40	78	20	40	2.1	4.0	1.7	2.0	15	30
Iosco stony loamy sand, 0 to 2 percent slopes														
Iosco loamy sand, deep variant	45	90	9	17	40	80	30	40	1.9	4.0	1.2	2.5	15	30
Kendallville sandy loam, 2 to 6 percent slopes	55	102	11	18	50	85	35	50	2.5	4.4	1.3	2.4	23	32
Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded	48	100	9	18	48	82	30	48	2.5	4.4	1.2	2.3	22	30
Kendallville sandy loam, 6 to 12 percent slopes	45	87	9	17	45	75	27	45	2.3	4.3	1.2	2.3	20	25
Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded	40	82	8	16	40	70	24	38	2.3	4.3	1.1	2.1	19	24
Kibbie loam, 0 to 2 percent slopes	60	95	12	17	55	90	30	45	2.5	4.0	1.4	2.5	20	37
Kibbie loam, 2 to 6 percent slopes	55	95	11	17	50	88	28	45	2.3	4.0	1.2	2.5	18	37
Lapeer sandy loam, 2 to 6 percent slopes	45	95	9	17	40	78	30	40	2.3	3.6	1.5	2.3	17	28
Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	40	82	8	16	35	55	25	37	2.1	3.3	1.4	2.2		
Lenawee silt loam	50	110	9	18	50	95	25	55	2.1	4.8	1.7	2.5	17	40
Linwood muck	60	100	12	18						3.8	1.6	2.3		
Locke sandy loam, 0 to 2 percent slopes	50	85	9	17	50	80	25	38	2.4	3.9	2.0	2.3	19	35
Locke sandy loam, 2 to 6 percent slopes	45	82	9	16	45	78	23	35	2.4	3.9	2.0	2.3	19	34
Macomb loam, 0 to 2 percent slopes	50	95	9	17	50	92	25	53	2.4	4.2	2.0	2.3	22	38
Macomb sandy loam, 2 to 6 percent slopes	45	93	9	17	45	90	23	51	2.4	4.2	2.0	2.3	19	36
Made land														
Mancelona loamy sand, 0 to 2 percent slopes	35	65	7	13	30	55	22	32	1.8	2.9	1.0	2.0	12	23
Mancelona loamy sand, 2 to 6 percent slopes	30	63	6	12	28	53	20	30	1.7	2.8	.9	1.9	10	22
Matherton sandy loam, 0 to 2 percent slopes	50	92	9	17	50	80	25	38	2.4	3.9	2.0	2.3	19	34

TABLE 2.—*Predicted average yields under two levels of management*—Continued

Soil	Corn				Oats		Wheat		Alfalfa-brome hay		Mixed hay		Field beans and soybeans	
	Grain		Silage											
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Bu.	*Bu.*	*Tons*	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*
Matherton sandy loam, 2 to 6 percent slopes	40	90	8	17	40	78	22	36	2.4	3.9	2.0	2.3	18	33
Matherton sandy loam, loamy substratum, 0 to 2 percent slopes	60	105	12	19	55	90	30	48	2.4	4.5	2.1	2.5	20	37
Matherton sandy loam, loamy substratum, 2 to 6 percent slopes	55	102	11	18	45	88	27	45	2.4	4.0	2.1	2.5	20	36
Menominee loamy sand, 2 to 6 percent slopes	50	80	9	16	35	60	22	35	1.9	3.3	1.2	2.0	----	----
Menominee loamy sand, 6 to 12 percent slopes	35	70	7	14	30	52	20	32	1.5	3.1	1.2	2.0	----	----
Metamora loamy sand, 0 to 2 percent slopes	45	90	9	17	40	83	30	40	1.9	3.8	1.2	2.5	16	34
Metamora sandy loam, 0 to 2 percent slopes	55	100	11	18	50	88	33	46	2.1	4.0	1.3	2.6	18	36
Metamora sandy loam, 2 to 6 percent slopes	50	95	9	17	45	86	32	43	2.0	4.0	1.3	2.6	17	35
Miami loam, 2 to 6 percent slopes	55	105	11	19	50	88	37	52	2.6	4.5	1.5	2.4	20	30
Miami loam, 2 to 6 percent slopes, moderately eroded	47	102	9	18	45	85	32	50	2.6	4.5	1.2	2.1	15	28
Miami loam, 6 to 12 percent slopes	45	90	9	17	42	78	28	42	2.4	4.4	1.2	2.4	16	24
Miami loam, 6 to 12 percent slopes, moderately eroded	40	85	8	17	38	72	25	40	2.4	4.3	1.1	2.3	----	----
Miami loam, 12 to 18 percent slopes, moderately eroded	----	----	----	----	30	60	20	35	2.2	4.0	1.0	2.1	----	----
Miami loam, 18 to 25 percent slopes, moderately eroded	----	----	----	----	----	----	----	----	1.5	3.0	1.0	2.1	----	----
Miami clay loam, 12 to 18 percent slopes, severely eroded	----	----	----	----	----	----	----	----	1.3	2.6	.8	1.5	----	----
Mine pits	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Newaygo sandy loam, 2 to 6 percent slopes	45	90	9	17	50	80	30	45	2.2	4.0	1.6	2.3	14	28
Ottokee loamy sand, 0 to 2 percent slopes	30	65	6	13	25	45	17	32	1.5	3.0	1.0	2.1	----	----
Owosso-Miami sandy loams, 2 to 6 percent slopes	50	103	9	19	45	86	32	50	2.6	4.3	1.3	2.4	23	32
Owosso-Miami sandy loams, 6 to 12 percent slopes	45	88	9	18	40	75	30	42	2.2	4.2	1.3	2.3	22	28
Owosso-Miami sandy loams, 12 to 18 percent slopes, moderately eroded	----	----	----	----	30	58	27	32	1.9	3.3	1.2	2.2	----	----
Plainfield loamy sand, slightly acid variant, 2 to 6 percent slopes	30	45	6	9	25	40	15	25	1.4	2.8	1.1	1.9	----	----
Plainfield loamy sand, slightly acid variant, 6 to 12 percent slopes	----	----	----	----	20	35	15	22	1.4	2.4	1.1	1.9	----	----
Richter loamy fine sand, 0 to 2 percent slopes	30	78	6	16	40	75	22	35	2.3	3.7	1.5	1.8	15	30
Sebewa loam	55	90	11	17	50	90	25	46	2.1	3.9	1.7	2.5	17	40
Shoals loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sloan loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Spinks loamy sand, 0 to 2 percent slopes	35	60	7	12	30	48	20	33	1.5	2.9	1.0	2.1	----	----
Spinks loamy sand, 2 to 6 percent slopes	35	60	7	12	30	45	20	30	1.5	2.7	1.0	2.1	----	----
Spinks loamy sand, 6 to 12 percent slopes	30	50	6	10	21	38	14	25	1.3	2.5	1.0	1.7	----	----
Spinks loamy sand, 12 to 18 percent slopes	----	----	----	----	18	32	12	20	1.3	2.5	1.0	1.7	----	----
Tawas muck	50	80	10	16	----	----	----	----	----	3.4	1.6	2.3	----	----
Tuscola loam, 2 to 6 percent slopes	45	95	9	17	40	80	30	45	2.0	4.0	1.5	2.3	17	28
Wallkill loam	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Wasepi sandy loam, 0 to 2 percent slopes	45	80	9	16	35	75	22	36	2.3	3.7	1.9	2.3	18	32
Wasepi sandy loam, 2 to 6 percent slopes	40	78	8	16	35	65	20	34	2.3	3.7	1.9	2.3	18	30

The figures in columns A represent recorded yields under prevailing management. At this level of management, some legume-grass crops are included in the cropping system, but generally little consideration is given to the suitability of the cropping system for the soil; available barnyard manure is returned to the soil; lime is applied, but in many places in insufficient amounts and not according to recommendations based on soil tests; some fertilizer is applied; poorly drained soils are cultivated without being artificially drained, so partial crop failures caused by excess water are common; and erosion control and other management practices are not used to the fullest advantage.

The figures in columns B represent yields obtained under improved management, which includes most of the following: suitable cropping systems, in which the proper proportion of row crops to legume-grass crops is maintained; measures, such as contour tillage, stripcropping, minimum tillage, and return of crop residue, for example, are used as needed to control water erosion and soil blowing; applications of lime and fertilizer in accordance with the results of soil tests and the requirements of the crop; adequate artificial drainage, where needed; use of improved varieties of crops and of high-quality seed; control of weeds, diseases, and insects; suitable and well-timed tillage and harvesting; and utilization of cover

crops, crop residue, and manure to improve soil structure, supply organic matter, and help control erosion.

These yields are averages for a period of several years under the specified level of management. The predictions for improved management are not presumed to be the maximum obtainable; the potential yields under a favorable combination of conditions are somewhat higher. Irrigation is not considered in predicting yields under improved management, because it is used only to a small extent except for truck crops and fruit.

Woodland [3]

At one time Shiawassee County was almost entirely covered by forest and was considered a part of the Great Michigan Pinery. Cedar and tamarack grew in wet bogs, hardwoods grew in wet lowlands, and hardwoods and pine grew on uplands and terraces.

The first logging of timber for lumber began around 1865 and continued until about 1880. As cutting progressed, its purpose ultimately became clearing and stump removal to make farmland. All of the old growth has now been removed. Trees now growing throughout the various woodlands originated by natural means or from planting.

Presently, about 11 percent, or 36,300 acres, of the county is woodland. It is expected that eventually about 8 percent or 26,900 acres of the county will remain in woodland. These woodlands are scattered throughout the county, and the largest areas are in soil associations 3 and 4 (see general soil map).

Soils of capability classes VI and VII make up only about 800 acres of the existing woodland. These soils need a permanent cover of trees or other vegetation, and it is expected that the acreage of woodland will eventually increase slightly. The potential for expansion is about 4,400 acres, much of which is now in pasture or used for crops.

Soils of capability classes II, III, and IV make up about 35,500 acres of the existing woodland. These are the soils most likely to be cleared for farming or other uses.

Cutting practices and grazing have tended to deplete the woodlands. "High-grading" or "creaming," a form of economic selection, has continually removed trees in highest demand. The less desirable culls and low-value trees commonly occupy a large part of many woodlands. Income from wood products is primarily a supplemental source of income to farmers in the county.

Woodland conservation practices can, in time, restore the woodlands as a more valuable resource. Protection from grazing, the killing of culls, and removal and use of low-value trees help in this development. An organized management approach for individual ownerships is the beginning step in achieving this goal.

Unmanaged woodlands on some soils are rated as capable of producing as much as 325 board feet per acre per year. Intensive management brings in higher net yields in places. Rotations, improvement, and intermediate harvesting cycles need to be carefully planned. Higher income can also be brought about by careful species management and consideration of market trends.

[3] JACQUES PINKARD, woodland conservationist, Soil Conservation Service, helped prepare this section.

Woodland suitability groups

To assist owners in planning the use of their soils for woodland, the soils of Shiawassee County have been placed in 10 woodland suitability groups. Woodland groups are established on a statewide basis, and some Michigan groups are not represented in Shiawassee County. Miscellaneous land types—Gravel pits, Made land, and Mine pits—are not placed in woodland suitability groups, because these areas require specific recommendation from local soil conservationists or forestry technicians if they are managed for woodland. The names of the soils series represented are mentioned in the description of each woodland group, but this does not mean that all soils of a given series are in the group. The names of all the soils in a woodland group can be found by referring to the "Guide to Mapping Units" at the back of this survey.

Each group described in this survey consists of soils that are similar in productivity, in management needs and response to management, and in requirements for conservation practices. The factors considered in placing each soil in a woodland group include productivity; species priority; and soil-related hazards and major limitations to be considered in management.

PRODUCTIVITY.—The information given in this survey on productivity of a particular group of soils for a given species of trees is based on the average annual growth rate of fully stocked, well-managed stands that have not been affected by special practices, such as artificial drainage or fertilization. Fully stocked stands have the required amount of good growing stock to produce maximum growth per acre.

The number of trees in a fully stocked stand depends on tree species and size and age classes of the trees in the stand. Well-managed stands will sustain production and maintain fully stocked stands. They are improved and harvested by timely and orderly cuttings and are protected from fire and livestock. Many of the stands in Shiawassee County are overstocked with undesirable species, but sufficient quantities of desirable species are generally present to make management of the stands feasible.

Table 3 gives the productivity ratings for woodland types. These ratings are expressed as averages and ranges of annual growth in board feet and cords per acre. They reflect, in part, the effects of soil; climate, particularly drought; insects or diseases that are associated with particular soils or are common in the area; genetic influences; and other common factors that affect the development of a stand of trees, even under good management.

SPECIES PRIORITY.—The information given on species priority for the woodland suitability groups is based on adaptability, productivity, and commercial value of the predominant species of trees that grow on the soils of a group. The first species listed has the highest priority and should be given the most consideration when making improvement harvest cuttings or new plantings.

SEEDLING MORTALITY.—Unfavorable soil characteristics prevent the survival of some healthy natural or properly planted seedlings. High water table, extreme acidity,

TABLE 3.—*Potential productivity ratings per acre per year*

[International board rule, ¼ inch key[1]; > means more than, and < means less than]

Productivity rating	Board feet		Cords	
	Average	*Range*	*Average*	*Range*
Very high	>325	325–350	1. 5	1. 5–1. 7
High	300	270–325	1. 3	1. 0–1. 5
Medium	240	200–270	. 8	0. 6–1. 0
Low	160	125–200	. 3	0. 1–0. 6
Very low	<125	<125	. 07	<0. 1

[1] Prepared by a committee of Michigan foresters and soil scientists representing the U.S. Forest Service, Michigan Conservation Department, University of Michigan, Michigan State University, Michigan College of Mining and Technology, Michigan Extension Service, and the U.S. Soil Conservation Service. Estimates were based on some research and on field experience and observations. As additional research data become available, these production estimates may be altered to some degree.

droughtiness, and high soil temperature are some of the soil properties that kill some seedlings. A seedling mortality rating of *slight* indicates that ordinary losses from these causes are not more than 25 percent of the planted stock. A rating of *moderate* indicates that losses are between 25 and 50 percent of the planted stock. A rating of *severe* indicates that more than 50 percent of the planted stock are likely to die.

PLANT COMPETITION.—When a site has been disturbed by fire, cutting, or other factors, undesirable species of brush, trees, grass or other plants invade the site in places. Vegetation competes with and hinders the establishment and growth of a desirable species. A plant competition rating of *slight* indicates that invasion by undesirable trees does not impede the establishment or growth of natural or planted stands of the preferred kinds of trees. No special management to control competition is needed. A rating of *moderate* indicates that competing plants do not ordinarily prevent the establishment of adequate stands of desirable kinds of trees. Development of fully stocked stands may take longer. Establishment of seedlings is delayed, and early growth is slow. Management practices that eliminate or retard competition will speed up establishment and growth of seedlings. A rating of *severe* indicates that natural reestablishment of stands cannot be relied upon. Establishment of stands by tree planting is poor, unless competing vegetation is controlled.

EQUIPMENT LIMITATIONS.—Some soil characteristics and topographic features, such as drainage, slope, number or size of stones, or soil texture, restrict or make impossible the use of equipment commonly used in woodland management and harvesting. Special equipment, special methods of equipment operation, or the use of equipment in only certain seasons is necessary on some soils. An equipment limitation rating of *slight* indicates that there is no special problem in the use of equipment. A rating of *moderate* indicates that not all types of equipment can be used; that there are short periods when equipment cannot be used, because of wetness or steep slopes; or that looseness of the soil makes hand planting and use of special logging techniques necessary. A rating of *severe* indicates that the type of equipment that can be used is very limited. Either the soil is so wet that equipment cannot be used for long periods of time, or the soil is so extremely steep or loose that the use of motorized equipment is dangerous and difficult. In some areas saw logs must be hauled from the slopes by a winch.

EROSION HAZARD.—It is possible to protect woodland from erosion and to prevent excessive surface runoff by growing adapted species of trees, by adjusting the rotation age and cutting cycles, by laying out new plantings on the contour, and by careful construction and maintenance of roads, trails, and landings. When runoff is diverted from cultivated fields into wooded areas, the erosion hazard, the slope, and the ground cover in the woods should be such that gullies do not form. An erosion hazard rating of *slight* indicates that little or no erosion has taken place and that erosion can be prevented by normal management practices. A rating of *moderate* indicates that the soils are subject to some water or wind erosion or both and that excessive disturbance or removal of the forest litter should be avoided. A rating of *severe* indicates that the hazard of erosion is severe to very severe and that applicable erosion control measures, such as those already mentioned, should be used.

WINDTHROW HAZARD.—Certain soil characteristics, such as the presence of a high water table or shallow depth to bedrock, affect the development of tree roots and, in turn, determine the resistance of trees to the force of the wind. The degree of windthrow hazard is important in the choice of tree species for planting and in the planning of release or harvest cuttings. A windthrow hazard rating of *slight* indicates that the roots of trees of adapted species develop normally and that windthrow is not a problem. A rating of *moderate* indicates that the trees remain standing, unless the wind velocity is high during the time the soil is excessively wet. A rating of *severe* indicates that the soil does not allow adequate rooting for stability of the trees or that the tree roots are not firm.

WOODLAND SUITABILITY GROUP C

This group consists of well-drained soils of the Boyer, Mancelona, and Menominee series. These soils have a surface layer of loamy sand or sandy loam and a subsoil of loamy sand to gravelly sandy clay loam. One Boyer soil is very stony and has stones 10 to 20 inches in diameter in the surface layer and 5 to 30 feet apart on the surface.

Permeability is mostly moderately rapid, but it is moderately slow in the loamy underlying material of the Menominee soils. Available water capacity is mostly low, but it is moderate in the loamy underlying material of the Menominee soils. Fertility generally is low. The slope range is 0 to 25 percent.

The potential productivity is low to medium for oaks, medium to high for other hardwoods, high for pines, medium for aspen, and high for spruce.

Species preferred in natural stands are black cherry, sugar maple, basswood, and white oak. Species preferred for planting are white pine, red pine, and white spruce.

Seedling mortality is slight in native and planted stands; plant competition is slight or moderate; and equipment limitation, erosion hazard, and windthrow hazard are mainly slight. Equipment limitation is severe on the very stony Boyer soil.

Use of equipment is restricted in a few areas by steep slopes, stones, and the loose, sandy condition of the soils. Building roads and trails on the contour as well as adjusting road grades and staying out of drainageways facilitates the use of equipment and prevents excessive erosion on steep soils.

WOODLAND SUITABILITY GROUP D

This group consists of moderately well drained and well drained soils of the Celina, Kendallville, Miami, and Owosso series. These soils have a surface layer of sandy loam, loam, or clay loam and a subsoil of sandy loam to clay loam.

Permeability is mostly moderate or moderately slow, but it is moderately rapid above the lower part of the subsoil of the Owosso soils. Available water capacity and fertility are mostly high. The slope range is 2 to 25 percent.

The potential productivity is high for aspen, oak, and other hardwoods; low for pines; and high for spruce. Spruce does not grow naturally.

Species preferred in natural stands are white oak, red oak, sugar maple, and black walnut. Species preferred for planting are white pine, black walnut, and tulippoplar.

Seedling mortality is slight in native and planted stands, plant competition is moderate, equipment limitation is slight or moderate, erosion hazard is moderate, and windthrow hazard is slight.

Eroded areas have poor tilth and less desirable texture for planting than uneroded areas. Poor surface tilth and increased runoff on these eroded areas reduce soil aeration and available water capacity. Building roads and trails on the contour facilitates the use of equipment and prevents excessive erosion on steep soils.

WOODLAND SUITABILITY GROUP E

This group consists of moderately well drained and well drained soils of the Ottokee series, Plainfield series, slightly acid variant, and Spinks series. These soils have a surface layer of loamy sand and a subsoil of sand to loamy sand.

Permeability is moderately rapid or rapid. Available water capacity and fertility are low. The slope range is 0 to 18 percent.

The potential productivity is low to medium for hardwoods, medium to high for pines and aspen, and very low to low for spruce.

Species preferred in natural stands are white oak, red oak, black cherry, and aspen. Species preferred for planting are red pine and white pine.

Seedling mortality is slight in native and planted stands, plant competition is slight, equipment limitations and erosion hazard are slight, and windthrow hazard is slight.

Use of equipment is restricted in a few areas by moderately steep slopes and loose, sandy condition of the soils. Building roads and trails on the contour facilitates the use of equipment and prevents excessive erosion on moderately steep soils.

WOODLAND SUITABILITY GROUP G

This group consists of somewhat poorly drained soils of the Belding, Gladwin, Iosco, Iosco, deep variant, Kibbie, Locke, Matherton, Metamora, Richter, and Wasepi series. These soils have a surface layer of loamy sand, loamy fine sand, or sandy loam and a subsoil of sand to clay loam. One Iosco soil has stones 10 to 20 inches in diameter in the surface layer and 5 to 30 feet apart on the surface.

Permeability is mostly moderately rapid or moderate, but it is moderately slow in the loamy underlying material of the Belding, Iosco, Matherton, and Metamora soils. Available water capacity is mostly moderate but ranges from low to high. Fertility is mostly medium but ranges from low to high. The slope range is 0 to 6 percent.

The potential productivity is low for hardwoods, low to medium for aspen, very low to low for pines, and medium for spruce.

Species preferred in natural stands are aspen, white ash, red maple, pin oak, and red oak. Species preferred for planting if the soil is drained are Norway spruce, white spruce, American arborvitae, and white pine.

Seedling mortality and plant competition are severe, equipment limitation is moderate, erosion hazard is slight, and windthrow hazard is moderate. Soil blowing is a hazard during dry periods, especially on the loamy sand soils.

Special site preparation or measures for controlling plant competition are needed. Use of equipment is restricted or prevented by excess wetness during spring and other wet periods. The wet periods generally last about 3 months. Careless use of equipment destroys the protective cover. Use of equipment on the stony Iosco soil is difficult because numerous large stones are on the surface.

WOODLAND SUITABILITY GROUP J

This group consists of very poorly drained soils of the Carlisle, Edwards, Linwood, Tawas, and Wallkill series. The Wallkill soils have a surface layer of loam, and the other soils have a surface layer of muck. The Carlisle soil is made up of muck, mucky peat and peat to a depth of about 42 inches. The Edwards, Linwood, and Tawas soils are made up of muck or mucky peat. The Edwards soil is underlain, at a depth of 12 to 42 inches, by marl; the Linwood soil, by light clay loam; and the Tawas soil, by sand. The Wallkill soil has a subsoil of clay loam underlain, at a depth of 10 to 40 inches, by muck. Permeability is moderately rapid in the organic material and is variable in the underlying material, ranging from moderately slow to rapid. Available water capacity is very high in the organic material and is variable in the underlying material, ranging from low to very high. Fertility is mostly low. The slope range is 0 to 2 percent.

The potential productivity is generally low and extremely variable. Little information has been gathered or is available.

Selection of species for management or planting is governed mainly by depth to water table and degree of saturation of the soils.

Existing woodlands consist of soft maple, elm, whitecedar, and alder. Species preferred for planting in windbreaks only are Norway spruce, white pine, Scotch pine, and purple willow. Excessive wetness, severe competition, and severe windthrow hazard make establishment of trees by planting very difficult.

Seedling mortality is severe, plant competition and equipment limitations are severe, erosion hazard is slight, and windthrow hazard is severe. The windthrow hazard is severe because of the unstable condition of the soils and the shallow root zone.

Use of equipment is severely restricted because of the high water table and poor capacity of most soils to support loads. Harvesting is limited to winter months when the soil is frozen.

WOODLAND SUITABILITY GROUP O

This group consists of poorly drained to moderately well drained soils of the Abscota, Algansee, Ceresco, Cohoctah, Eel, Glendora, Landes, Shoals, and Sloan series. These soils have a surface layer of sandy loam or loam and a subsoil or underlying material of sand to clay loam. The Landes and Abscota soils are well drained.

Permeability is mostly moderate or moderately rapid but ranges to rapid. Available water capacity is mostly moderate or high. Fertility is mostly medium or high. The slope range is 0 to 2 percent.

Potential productivity is extremely variable and is difficult to determine. The productivity and the woodland type vary with the frequency and severity of flooding. Drainage and texture affect woodland cover type and productivity even if flooding is of little or no concern.

Plant competition delays and in many cases prevents the reestablishment of the stand by natural methods. Tree planting is limited to cottonwood or sycamore. Special site preparation and practices to control plant competition are needed to assist natural reseeding and tree planting.

Seedling mortality is moderate in native stands and severe in planted stands; plant competition and equipment limitations are moderate or severe. The erosion hazard is slight, except for some streambank cutting or bank gullying, and windthrow hazard is moderate or severe. Windthrow occurs if trees are released on all sides, generally during periods of flooding and high winds.

Equipment limitation is a seasonal problem. Use of equipment is restricted or prevented by flooding or wetness for about 3 months of the year.

WOODLAND SUITABILITY GROUP P

This group consists of poorly drained soils of the Berville, Brookston, and Lenawee series. These soils have a surface layer of loam or silt loam and a subsoil of gravelly sandy clay loam to silty clay loam.

Permeability is moderately slow. Available water capacity and fertility are high. The slope range is 0 to 2 percent.

Potential productivity is low for oaks and other hardwoods and low to medium for aspen and spruce. Pine does not occur naturally.

Species preferred in natural stands are red maple, wetland oaks, white ash, and basswood. Planting ordinarily is not practical unless the soils are drained and special site preparation practices are used. If drained, white spruce, Norway spruce, and white pine can be planted.

Seedling mortality, plant competition, and equipment limitations are severe; erosion hazard is slight; and windthrow hazard is severe. Windthrow restricts the method of harvesting trees on these soils. Special practices, such as clear cutting in strips or patches, help to reduce the windthrow hazard.

Operation of equipment has to be curtailed or suspended for more than 3 months of the year because of excess wetness. Damage to tree roots is possible if care is not exercised in the use of equipment.

WOODLAND SUITABILITY GROUP U

This group consists of moderately well drained or well drained soils of the Fox, Lapeer, Newaygo, and Tuscola series. These soils have a surface layer of sandy loam or loam and a subsoil of very fine sandy loam to gravelly clay loam.

Permeability and available water capacity are mostly moderate. Fertility is mostly medium. The slope range is 2 to 18 percent.

Potential productivity is high for oaks and hardwoods, high to very high for pines and aspen, and high for spruce. Spruce does not occur naturally.

Species preferred in natural stands are red oak, white ash, white oak, sugar maple, and black walnut. Species preferred in planting are white pine, red pine, black walnut, tulip-poplar, or white ash.

Seedling mortality is slight in native and planted stands, plant competition is moderate, equipment limitations and erosion hazard are slight or moderate, and windthrow hazard is slight.

Erosion is not a serious hazard. Wheel tracks wash or become pitted where the slope is more than 6 percent. Roads, trails, tree plantings, and logging operations should be kept on the contour.

WOODLAND SUITABILITY GROUP W

This group consists of poorly drained soils of the Barry series, the bedrock variant of the Barry series, and Breckenridge, Brevort, Colwood, Gilford, Granby, and Sebewa series. These soils have a surface layer of loamy sand, sandy loam, or loam and a subsoil of sand to clay loam. Gilford soil has stones 10 to 20 inches in diameter in the surface layer and 5 to 30 feet apart on the surface.

Permeability is mostly moderate or moderately rapid, but it is moderately slow in the loamy underlying material of the Breckenridge and Brevort soils. Available water capacity is mostly low or moderate. Fertility is mostly medium but ranges from low to high. The slope range is 0 to 2 percent.

Potential productivity is low to very low for hardwoods and medium for aspen. Pine and spruce do not occur naturally.

Species preferred in natural stands are pin oak, red maple, white ash, and basswood. Tree planting is not successful unless the soils are drained and special site preparation practices are used. If drained, white spruce, Norway spruce, or white pine can be planted.

Seedling mortality, plant competition, and equipment limitations are severe; erosion hazard is slight; and windthrow hazard is severe.

Use of equipment is restricted because of a high water table in most areas. A high water table also restricts the downward growth of tree roots, thereby resulting in a severe windthrow hazard. Use of equipment is severely

restricted on the stony Gilford soil because of the presence of numerous large stones and the high water table.

WOODLAND SUITABILITY GROUP Z

This group consists of somewhat poorly drained soils of the Conover and Macomb series. These soils have a surface layer of loam or sandy loam and a subsoil of gravelly clay loam or clay loam.

Permeability is moderately slow. Available water capacity and fertility are high. The slope range is 0 to 6 percent.

Potential productivity is low to medium for oaks and other hardwoods and medium for spruce and aspen. Pine does not occur naturally.

Species preferred in natural stands are white ash, red maple, sugar maple, red oak, and white oak. Species preferred for planting are white pine, white ash, and red maple. In many areas drainage is needed if tree planting is to be successful.

Seedling mortality is moderate, plant competiton is severe, equipment limitation is moderate, erosion hazard is slight, and windthrow hazard is slight.

Plant competition, insect and disease hazard, and excessive wetness make establishment of trees difficult. Special site preparation and control of plant competition by either chemical or mechanical means are needed. Excessive wetness limits use of equipment. Seasonal restrictions of up to 3 months exist each year. Logging during these wet months also causes damage to tree roots and soil structure.

Wildlife [4]

Table 4 shows the relative suitability of the soils of Shiawassee County for eight elements of wildlife habitat and for three general kinds of wildlife. The ratings indicate, in a general way, what areas can be managed as wildlife habitat with a reasonable prospect of success and what level of management is necessary. Present land use, existing vegetation, and artificial drainage were not considered in these ratings, because these factors are subject to change. Size and location of areas, association with other soils, and ability of wildlife to move from place to place were also not considered. Explanations of the ratings are given at the beginning of table 4.

The soils of each series are rated as not suited, poorly suited, suited, or well suited for each of the following:

GRAIN AND SEED CROPS.—In this group are corn, wheat, oats, barley, rye, buckwheat, sorghum, soybeans, navy beans, and pinto beans.

GRASSES AND LEGUMES.—In this group are some of the commonly planted forage plants. Examples are bromegrass, fescue, timothy, redtop, orchardgrass, clover, alfalfa, and sudangrass.

WILD HERBACEOUS UPLAND PLANTS.—In this group are native annuals and perennials. Examples are strawberries, dandelions, goldenrod, wild oats, nightshade, ragweed, lambsquarters, and native grasses.

HARDWOOD WOODY PLANTS.—In this group are hardwood trees and shrubs that produce vigorous growth and heavy crops of fruit or seed and that grow naturally or are planted. Examples are maple, beech, oak, elderberry, poplar, birch, dogwood, raspberry, blackberry, cherry, hawthorn, viburnum, grape, blueberry, willow, and wintergreen.

CONIFEROUS WOODY PLANTS.—In this group are native or planted coniferous trees and shrubs. Examples are pine, spruce, arborvitae, hemlock, balsam fir, yew, larch, and juniper.

WETLAND FOOD AND COVER PLANTS.—In this group are wetland plants that provide food and cover for waterfowl and furbearing animals. Examples are cattails, sedge, bulrush, smartweed, wild millet, water plantain, arrowhead, pondweed, pickerelweed, wild celery, duckweed, and burreed.

SHALLOW WATER DEVELOPMENTS.—In this group are impoundments in which shallow water can be maintained at a desirable level. Examples are low dikes, level ditches, shallow dugouts, and devices for water level control on marshy streams or channels.

EXCAVATED PONDS.—In this group are ponds of the excavated or dugout type. Migrating waterfowl are especially attracted to such ponds. The ponds must not be solely dependent on runoff from surrounding areas, although they may be benefited by such runoff if it is not excessive and does not cause too much siltation.

The ratings of the soils for kinds of wildlife are based upon weighted values of the habitat elements considered important to each type. The kinds are designated as:

OPENLAND WILDLIFE.—These are birds and mammals that normally frequent cropland, pasture, meadow, and areas overgrown with grass, herbs, and shrubs. Examples are quail, pheasant, meadowlarks, field sparrows, red fox, cottontail rabbits, small rodents, woodchucks, and hawks.

WOODLAND WILDLIFE.—These are birds and mammals that normally frequent areas of hardwood trees, coniferous trees, shrubs, or mixed stands of trees and shrubs. Examples are squirrels, raccoons, ruffed grouse, woodcocks, woodpeckers, warblers, nuthatches, white-tailed deer, and owls.

WETLAND WILDLIFE.—These are birds and mammals that normally frequent ponds, marshes, and swamps. Examples are muskrat, beaver, ducks, geese, herons, rails, kingfishers, minks, cranes, and bitterns.

Recreation

The nature of the soils is an important factor in determining whether a given location is suitable for a particular type of recreational facility. The soils of Shiawassee County have been placed in seven recreation groups, according to similarity in kind and degree of limitation for four major recreational uses: picnic areas, intensive play and sport areas, intensive campsites, and paths and trails.

Picnic areas are expected to be used for extensive play activities as well as for picnicking. The soils most desirable for such uses are nearly level to gently sloping, well drained, and not subject to flooding during the season of use. They have a texture and consistence that provide a firm surface, are free of stones, and can support a good cover of vegetation.

[4] BRUCE G. WATSON, soil scientist, and CHARLES M. SMITH, biologist, Soil Conservation Service, prepared this section.

TABLE 4.—*Suitability of soils for elements*

["Well suited" means the soils have no limitations that cannot easily be overcome; "suited" means limitations need to be recognized but for wildlife habitat is questionable; "not suited" means extreme measures would be needed to

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Abscota	Poorly suited	Suited	Suited	Suited
Mapped only with Eel and Landes soils.				
Algansee: Ah	Suited	Suited	Suited	Suited
Barry: Ba, Bc	Not suited	Poorly suited	Suited	Suited
Barry, bedrock variant: Bb	Not suited	Poorly suited	Poorly suited	Suited
Belding: BeA	Suited	Suited	Well suited	Suited
Berville: Bh	Not suited	Poorly suited	Poorly suited	Well suited
Boyer: BmA, BmB, BmC, BrA, BrB, BrC.	Suited	Well suited	Well suited	Suited
BmD, BmE, BoB, BrD	Poorly suited	Suited	Well suited	Suited
Breckenridge: Bt	Not suited	Poorly suited	Poorly suited	Well suited
Brevort: Bv	Not suited	Poorly suited	Poorly suited	Not suited
Brookston: Bw	Not suited	Poorly suited	Poorly suited	Well suited
Carlisle: Cg	Not suited	Poorly suited	Not suited	Not suited
Celina: ChB, ChB2	Well suited	Well suited	Well suited	Well suited
Ceresco: Cm	Suited	Suited	Well suited	Suited
Cohoctah: Cn	Poorly suited	Suited	Suited	Suited
Colwood: Cs	Not suited	Poorly suited	Suited	Well suited
Conover: CtA, CtB	Suited	Suited	Well suited	Well suited
Edwards: Ek	Not suited	Poorly suited	Not suited	Not suited
Eel: En	Suited	Well suited	Well suited	Well suited
For Landes and Abscota part, see Landes and Abscota series.				
Fox:				
FoB	Suited	Well suited	Well suited	Well suited
FoC	Suited	Well suited	Well suited	Well suited
FoD	Poorly suited	Suited	Well suited	Well suited
Gilford: Gg, Gh	Not suited	Suited	Suited	Suited
Gladwin: GmA	Suited	Suited	Well suited	Suited
Glendora: Gn	Poorly suited	Suited	Poorly suited	Poorly suited
Granby: Go	Not suited	Poorly suited	Poorly suited	Poorly suited
Gravel pits: Gp.				
Individual areas require onsite investigation.				
Iosco: IsA, ItA	Not suited	Poorly suited	Poorly suited	Poorly suited
Iosco, deep variant: Iv	Not suited	Poorly suited	Poorly suited	Poorly suited
Kendallville:				
KhB, KhB2	Well suited	Well suited	Well suited	Well suited
KhC, KhC2	Suited	Well suited	Well suited	Well suited
Kibbie: KnA, KnB	Suited	Suited	Well suited	Well suited
Landes	Suited	Well suited	Well suited	Well suited
Mapped only with Eel and Abscota soils.				
Lapeer:				
LmB	Well suited	Well suited	Well suited	Well suited
LmC2	Suited	Well suited	Well suited	Well suited
Lenawee. Ln	Not suited	Poorly suited	Poorly suited	Well suited
Linwood: Lo	Not suited	Not suited	Not suited	Not suited
Locke: LsA, LsB	Suited	Suited	Well suited	Well suited
Macomb: MaA, MbB	Suited	Suited	Well suited	Well suited
Made land: Md.				
Individual areas require onsite investigation.				
Mancelona: MeA, MeB	Suited	Well suited	Well suited	Well suited
Matherton: MmA, MmB, MnA, MnB	Suited	Suited	Well suited	Suited
Menominee: MoB, MoC	Suited	Suited	Well suited	Suited
Metamora: MrA, MsA, MsB	Suited	Suited	Well suited	Well suited
Miami:				
MuB, MuB2	Well suited	Well suited	Well suited	Well suited
MuC, MuC2	Suited	Well suited	Well suited	Well suited
MuD2, MuE2, MvD3	Poorly suited	Suited	Well suited	Well suited

of wildlife habitat and kinds of wildlife

can be overcome through good management and careful design; "poorly suited" means limitations are severe, and the use of the soils overcome limitations, and use of the soils for wildlife habitat is generally unsound or impractical]

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poorly suited	Not suited	Not suited	Not suited	Suited	Poorly suited	Not suited.
Poorly suited	Suited	Suited	Suited	Suited	Poorly suited	Suited.
Suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Well suited	Well suited	Suited	Not suited	Poorly suited	Suited	Suited.
Suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Suited	Not suited	Well suited	Well suited	Poorly suited	Well suited	Poorly suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Poorly suited	Suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.
Poorly suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Not suited.
Suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Poorly suited	Poorly suited	Suited	Suited	Suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Suited	Well suited	Well suited	Poorly suited	Poorly suited	Well suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Poorly suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Suited	Well suited	Well suited	Well suited	Suited	Suited	Well suited.
Poorly suited	Poorly suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Poorly suited	Poorly suited	Suited	Poorly suited	Suited.
Not suited	Not suited	Well suited	Well suited	Not suited	Not suited	Suited.
Suited	Poorly suited	Suited	Suited	Poorly suited	Not suited	Poorly suited.
Poorly suited	Poorly suited	Suited	Suited	Poorly suited	Not suited	Poorly suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Poorly suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Poorly suited	Not suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Suited	Suited	Suited	Suited	Suited	Suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.

TABLE 4.—*Suitability of soils for elements*

Soil series and map symbols	Elements of wildlife habitat			
	Grain and seed crops	Grasses and legumes	Wild herbaceous upland plants	Hardwood woody plants
Mine pits: Mw. Individual areas need onsite investigation.				
Newaygo: NyB	Suited	Well suited	Well suited	Well suited
Ottokee: OkA	Not suited	Poorly suited	Poorly suited	Poorly suited
Owosso:				
OmB	Well suited	Well suited	Well suited	Well suited
OmC	Suited	Well suited	Well suited	Well suited
OmD2	Poorly suited	Suited	Well suited	Well suited
For Miami part, see Miami series.				
Plainfield, slightly acid variant: PfB, PfC.	Not suited	Poorly suited	Poorly suited	Poorly suited
Richter: RhA	Suited	Suited	Well suited	Suited
Sebewa: Sd	Not suited	Poorly suited	Poorly suited	Well suited
Shoals: Sh	Suited	Suited	Well suited	Suited
Sloan: Sn	Poorly suited	Suited	Suited	Suited
Spinks:				
SpA, SpB, SpC	Suited	Well suited	Well suited	Well suited
SpD	Poorly suited	Suited	Well suited	Well suited
Tawas: Ta	Not suited	Poorly suited	Not suited	Not suited
Tuscola: TsB	Well suited	Well suited	Well suited	Well suited
Wallkill: Wa	Not suited	Poorly suited	Poorly suited	Suited
Wasepi: WeA, WeB	Suited	Suited	Well suited	Well suited

Intensive play and sport areas are intended for use as playgrounds and as athletic fields for baseball, tennis, volleyball, and other organized games. Such areas are subject to heavy foot traffic. The soils need to be level or nearly level, well drained, and not subject to flooding. They should have a texture and consistence that provide a firm surface, be free of stones and other coarse fragments, and be able to support a good turf.

Intensive campsites are used for tent and trailer camping and the accompanying outdoor activities. The areas selected should be suitable, without surfacing and with little other site preparation, for the parking of cars and trailers, for heavy foot traffic, and for vehicular traffic. Significant factors are wetness and hazard of flooding, permeability, slope, surface texture, content of stones and other coarse fragments, and capacity to support vegetation.

Paths and trails, it is assumed, are to be used as they occur naturally, for cross-country hiking, horseback riding, and other intensive uses that involve the movement of people. The soils most desirable for these purposes are nearly level to sloping, are well drained, have a loamy texture, and are free of stones and other coarse fragments. They have good trafficability and good stability and are not subject to erosion. Placement of paths and trails on the contour in sloping areas helps to control erosion. Variations in slope may serve to enhance interest, but the slope should not exceed 12 percent for any great distance.

In the descriptions of the recreation groups, limitations that are easily overcome are rated as slight; limitations that are significant but can be overcome under good management and by careful design are rated as moderate; limitations that make the use of an area questionable are rated as severe; and limitations that can be overcome only by extreme measures and that make the use of an area impractical are rated as very severe. A rating of very severe, however, does not imply that an area cannot be developed for a given use if enough money and effort are expended to offset the limitations. The degrees of limitation are based on soil properties only; they do not reflect other considerations that might affect the suitability of a given site.

The information in this section provides a general guide in the location and development of parks and recreational areas, but it is not a substitute for a detailed, onsite investigation. Additional information can be found in the section "Descriptions of the Soils." To find the recreation group in which a specific soil has been placed, refer to the "Guide to Mapping Units" at the back of this survey.

RECREATION GROUP 1

This group consists of well drained or moderately well drained soils of the Boyer, Mancelona, Menominee, Ottokee, and Spinks series, and the Plainfield series and its slightly acid variant. These soils have a surface layer of loamy sand and sandy loam and a subsoil of sand to clay loam. One of the Boyer soils has stones 10 to 20 inches in diameter in the surface layer and 5 to 30 feet apart on the surface.

Permeability is moderately rapid or rapid. Fertility generally is low. Surface runoff is mostly slow, but it is medium to rapid where the slope is greater than 6 percent. The slopes range from 0 to 25 percent.

Most of these soils have moderate to severe limitations for use as picnic areas, camp areas, play and sport areas,

of wildlife habitat and kinds of wildlife—Continued

Elements of wildlife habitat—Continued				Kinds of wildlife		
Coniferous woody plants	Wetland food and cover plants	Shallow water developments	Excavated ponds	Openland wildlife	Woodland wildlife	Wetland wildlife
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Well suited	Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Poorly suited	Not suited	Not suited	Not suited	Suited	Suited	Not suited.
Well suited	Not suited	Not suited	Not suited	Poorly suited	Poorly suited	Not suited.
Suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Well suited	Well suited.
Poorly suited	Suited	Suited	Suited	Well suited	Suited	Suited.
Suited	Well suited	Poorly suited	Poorly suited	Suited	Suited	Suited.
Suited	Not suited	Not suited	Not suited	Well suited	Well suited	Not suited.
Suited	Not suited	Not suited	Not suited	Suited	Well suited	Not suited.
Poorly suited	Suited	Well suited	Well suited	Not suited	Poorly suited	Well suited.
Poorly suited	Poorly suited	Poorly suited	Poorly suited	Well suited	Well suited	Poorly suited.
Well suited	Well suited	Well suited	Well suited	Poorly suited	Suited	Well suited.
Suited	Suited	Suited	Suited	Well suited	Suited	Suited.

and paths and trails. The Boyer sandy loams have slight limitations for play and sports areas where the slope is 0 to 2 percent, for camp and picnic areas where the slope is 0 to 6 percent, and for paths and trails where the slope is 0 to 12 percent. The main limitations of most soils in this group are soil blowing, sandiness, low available water capacity, and slope. Stoniness is an additional limitation for the very stony Boyer soil.

These soils dry out rapidly in spring and after heavy rains and are dry for long periods in summer. They are subject to soil blowing when dry and exposed.

Turf generally is difficult to establish and maintain because of the low fertility and lack of moisture in the upper part of the rooting zone. These sandy soils have good trafficability for foot traffic when wet but become loose and difficult to walk on when dry.

Placement of tents, trailers, tables, and grills is difficult where the soils are stony or sloping to steep. Placing paths and trails on the contour reduces the erosion hazard and facilitates use. Extensive leveling is required for intensive play and sport areas if the slope is more than 2 percent.

Wooded areas and variations in relief provide pleasant views and hiking areas. Woodland and openland wildlife find suitable habitat.

The soils of this group provide good foundations for buildings, roads, and other structures. The less sloping areas have few limitations for septic tank filter fields.

RECREATION GROUP 2

This group consists of well drained or moderately well drained soils of the Celina, Fox, Kendallville, Lapeer, Miami, Newaygo, Owosso, and Tuscola series. These soils have a surface layer of sandy loam, loam, or clay loam and a subsoil of sandy loam to clay loam.

Permeability is moderate or moderately slow. Fertility is medium or high. Surface runoff is slow to very rapid, depending on soil texture, cover, and steepness. The slope range is 2 to 25 percent.

The limitation of these soils for recreation generally depends on the steepness of slopes. Gently sloping soils, 2 to 6 percent, have moderate limitations for play and sports areas. Sloping to steep soils, 6 to 25 percent, have severe limitations for play and sports areas, picnic areas, and campsites and moderate limitations for paths and trails.

Runoff and erosion are hazards in heavily used areas of the sloping to steep soils. Water collects in road ditches and readily forms gullies. Placing roads, trails, and paths on the contour, if possible, helps control erosion and facilitates movement of traffic.

Turf is generally easy to establish and maintain, but control of erosion is needed on sloping to steep soils.

The sandy loams readily support foot and vehicular traffic. The loams tend to be soft and muddy when wet, but they dry out quickly. The one clay loam in the group has generally poor trafficability, especially after rain, and is hard to maintain in turf.

In many areas there are pleasant views, sites suitable for recreational facilities, steep slopes suitable for skiing, and small woodlots in many areas that can be used for nature study and hiking. Woodland and openland wildlife are common.

Depending mostly on slope, these soils have slight to severe limitations for buildings, roads, and other struc-

tures. They have moderate to severe limitations for septic tank filter fields, depending on permeability and slope.

RECREATION GROUP 3

This group consists of somewhat poorly drained soils of the Belding, Conover, Kibbie, Locke, Macomb, Matherton, Metamora, Richter, and Wasepi series. These soils mostly have a surface layer of sandy loam or loam and a subsoil of loamy sand to clay loam.

Permeability is mostly moderately slow to moderately rapid. Fertility is mostly medium or high. Surface runoff is generally slow. During wet periods, water stands in depressions. The slope range is 0 to 6 percent.

These soils have moderate limitations for picnic areas, camp areas, play and sports areas, and paths and trails. The main limitations are excessive seasonal wetness and wetness for short periods after rain and fair to poor trafficability for foot and vehicular traffic during wet periods.

These soils have a seasonal high water table. The water table is commonly within 1 to 2 feet of the surface early in spring and in fall and is lower in summer. These soils generally dry out slowly in spring and after rains. The surface layer is soft and muddy when wet, and vehicles readily bog down in unpaved areas. Wet areas in depressions are numerous; they are breeding grounds for mosquitoes and other obnoxious insects.

Turf is generally easy to establish and maintain, but drainage is needed in places. Some leveling is needed for intensive play and sports areas where the slope is more than 2 percent.

Because most areas of these soils are used for crops or are idle, the esthetic potential is less than that of groups 1 and 2. There are small areas, however, that have pleasant views and are wooded.

These soils have moderate to severe limitations for buildings and septic tank filter fields because of a seasonal high water table.

RECREATION GROUP 4

This group consists of poorly drained soils of the Barry series and its bedrock variants, and of the Berville, Breckenridge, Brevort, Brookston, Colwood, Gilford, Granby, Lenawee, and Sebewa series. Most of these soils have a surface layer of loamy sand to silt loam and a subsoil of sand to clay loam. Barry stony loam has stones 10 to 20 inches in diameter in the surface layer and 30 to 100 feet apart on the surface. Gilford stony sandy loam has stones 10 to 20 inches in diameter in the surface layer and 5 to 30 feet apart on the surface.

Permeability is moderate or moderately slow in most soils in this group. Fertility is mostly medium or high. Surface runoff is very slow, and water ponds for long periods during the year. The slope range is 0 to 2 percent.

These soils have severe limitations for picnic areas, play and sports areas, camp areas, and paths and trails. The main limitations of these soils for recreation are wetness and poor trafficability for foot and vehicular traffic when wet. Stoniness is an additional limitation for the Barry and Gilford soils. A high water table is near the surface during much of the year unless the soil is drained.

Turf is generally easy to establish and maintain, but drainage is needed. Turf is difficult to establish and maintain on drained areas of Brevort and Granby soils because of low fertility and low soil moisture. These sandy soils are also susceptible to soil blowing if large areas of the surface are exposed. Wetness restricts hiking and horseback riding during spring and other wet periods. Because of wet conditions and dense vegetative cover, mosquitoes and other obnoxious insects are a problem in some areas.

Most areas of these soils have been cleared of trees and are now used for crops or are idle. As a result, the soil areas in this recreation group do not have the esthetic potential of recreation groups 1 and 2. There are small areas, however, that have pleasant views and are wooded.

These soils have severe limitations for buildings and septic tank filter fields because of a high water table or moderately slow permeability. The Barry soils, bedrock variant, have severe limitations for buildings and septic tank filter fields because sandstone bedrock is at depth of 24 to 40 inches.

RECREATION GROUP 5

This group consists of somewhat poorly drained soils of the Gladwin and Iosco series, and the deep variant of the Iosco series. These soils have a surface layer of loamy sand and a subsoil of sand to clay loam. One of the Iosco soils has stones 10 to 20 inches in diameter in the surface layer and 5 to 30 feet apart on the surface.

Permeability is moderately rapid or rapid. Iosco soils have moderately slow permeability in the lower part of the subsoil and in the underlying material. Fertility is low. Surface runoff is slow. The slope range is 0 to 2 percent.

These soils have moderate limitations for use as picnic areas, camp areas, play and sports areas, and paths and trails. The main limitations are seasonal wetness, low available water capacity, low fertility, and soil blowing. Stoniness is an additional limitation for the stony Iosco soil, which has severe limitations for use as play and sport areas.

These soils have a seasonal high water table. The water table is commonly within 1 to 2 feet of the surface early in spring and in wet weather in fall. It drops to a depth below 2 feet in summer. These soils dry out sooner in spring than loamy soils and are ready for use earlier.

Turf is difficult to establish and maintain because of the low fertility and lack of moisture in the upper part of the rooting zone. These soils have fair to good trafficability for foot traffic. The surface layer is loose and dusty in some areas during dry periods.

In many areas there are pleasant views, suitable sites for recreational facilities, and small woodlots that can be used for nature study and hiking. Woodland and openland wildlife are common.

The soils of this group generally have moderate limitations for buildings. They have severe limitations for septic tank filter fields because of a seasonal high water table.

RECREATION GROUP 6

This group consists of poorly drained to well-drained soils of the Abscota, Algansee, Ceresco, Cohoctah, Eel, Landes, Glendora, Shoals, and Sloan series. These soils

have a surface layer of sandy loam or loam and a subsoil of sand to loam.

Permeability is moderate to rapid. Fertility is low to high. Surface runoff is slow to ponded. The slope range is 0 to 2 percent.

These soils have moderate to severe limitations, depending on the frequency and severity of flooding, for picnic areas, play and sports areas, camp areas, and paths and trails. The main limitations of these soils for recreation are wetness and the flood hazard. The frequency of flooding is variable; it depends on the size of watershed and how high the areas are above the water level of the streams.

Because of the frequency of flooding and high water table, turf is generally difficult to establish and maintain. Intensive use is restricted to periods when the water levels are low and the surface layer is not wet. During wet periods, the soft, muddy surface layer hinders foot and vehicular traffic.

Many areas are presently in woodland or brush. Woodland, openland, and wetland wildlife are common. Because of the dense cover and ready access to water, mosquitoes and other obnoxious insects are a problem. Many of the bottom lands are inaccessible because of the meandering streams.

These soils generally have severe limitations for buildings and septic tank filter fields.

RECREATION GROUP 7

This group consists of very poorly drained soils of the Carlisle, Edwards, Linwood, Tawas, and Wallkill series. Except for Wallkill soil, these soils have a surface layer of muck and underlying material of muck, marl, light clay loam, and sand respectively. The Wallkill soil has a loam surface layer and a clay loam subsoil, 10 to 40 inches thick, over muck.

Permeability is mostly moderately rapid. Fertility is low. Surface runoff is very slow, and water stands on the surface for long periods during the year.

These soils have very severe limitations for picnic areas, play and sports areas, camp areas, and paths and trails. The main limitations of these soils for recreation are wetness and their very poor capacity to support foot and vehicular traffic when wet. When dry, the muck soils are subject to burning or blowing and become dusty and dirty.

A high water table is at or near the surface of these soils during much of the year. It drops several feet in some areas during extended dry periods. Turf is generally difficult to maintain.

The organic material does not support heavy loads, such as buildings, trailers, and automobiles. Maintenance of access roads is difficult because of the unstable condition of the soils. Wet conditions restrict hiking and horseback riding in spring and other wet periods. Because of the wet conditions and dense vegetation in many areas, mosquitoes and other obnoxious insects are a problem.

Many areas are wooded and can be used for nature study. Woodland wildlife and wetland wildlife are common in many areas.

These soils have very severe limitations for buildings and septic tank filter fields.

Engineering Uses of the Soils [5]

This section is useful to those who need information about soils used as structural material or as foundations for structures. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among the important properties of soils for engineering are permeability, strength, compaction characteristics, soil drainage condition, shrink-swell potential, grain size, plasticity, and soil reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 5, 6, 7, and 8 that show, respectively, the results of engineering laboratory tests of soil samples, estimates of several soil properties significant in engineering, interpretations for road building and community development, and interpretations for farm uses.

This information, along with the soil map and other parts of this survey, can be used to make interpretations in addition to those given in tables 7 and 8, and it also can be used to make other useful maps.

This information, however, does not eliminate need for further investigations at sites selected for engineering works, especially those that involve heavy loads or that require excavations to depths greater than those shown in the tables, generally depths greater than 6 feet. Also, inspection of sites, especially the small ones, is needed because many delineated areas of a given mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

[5] KEITH I. BAKEMAN, civil engineer, Soil Conservation Service, helped prepare this section.

Some of the terms used in this soil survey have a different meaning in soil science than in engineering. The Glossary defines many of these terms commonly used in soil science.

Engineering classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*7*) used by SCS engineers, Department of Defense, and others, and the AASHO system (*1*) adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, ML–CL.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system, a soil is placed in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A-7, are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A-1, A-2, and A-7 groups are divided as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for

TABLE 5.—*Engineering*

[Tests performed by the Bureau of Public Roads (BPR) in accordance with standard

Soil name and location of sample	Parent material	Bureau of Public Roads report No.	Depth from surface
			Inches
Macomb loam:			
NW¼NE¼NE¼ sec. 1, T. 6 N., R. 3 E.	Clay loam.	S41717	0–9
		S41718	14–23
		S41719	25–60
Macomb sandy loam:			
NE¼NE¼NE¼ sec. 14, T. 6 N., R. 4 E.	Clay loam.	S41711	0–8
		S41712	16–26
		S41713	30–60
Miami loam:			
NW¼NE¼NW¼ sec. 1, T. 6 N., R. 3 E. (Coarser textured than modal).	Loam.	S41720	0–8
		S41721	16–23
		S41722	30–60
NE¼SE¼NW¼ sec. 2, T. 6 N., R. 3 E. (Similar to modal)	Loam.	S41723	0–6
		S41724	13–22
		S41725	27–60
Wasepi sandy loam:			
SW¼SW¼NW¼ sec. 2, T. 6 N., R. 3 E. (Coarser textured than modal).	Loam.	S41729	0–10
		S41730	23–26
		S41731	28–60
SW¼SE¼SE¼ sec. 28, T. 7 N., R. 2 E. (Similar to modal)	Loam.	S41735	0–10
		S41736	20–27
		S41737	27–60

[1] Mechanical analyses according to AASHO Designation T 88 (*1*). Results by this procedure may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the ma-

the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 5; the estimated classification, without group index numbers, is given in table 6 for all soils mapped in the county.

Engineering test data

Table 5 contains engineering test data for three of the major soil series in Shiawassee County. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications given are based on data obtained by mechanical analysis and by tests to determine liquid limits and plastic limits. The mechanical analysis was made by combined sieve and hydrometer methods.

The terms for texture have different meanings in soil science than in engineering. To soil scientists, for example, clay refers to mineral grains less than 0.002 millimeter in diameter, but engineers frequently define clay as particles less than 0.005 millimeter in diameter. These terms as used in soil science are defined in the Soil Survey Manual (*4*).

Tests to determine liquid limit and plastic limit measure the effect of water on the consistence of soil material. As the moisture content of a clayey soil increases from a very dry state, the material changes from semisolid to plastic. As the moisture content is further increased, the material changes from plastic to liquid. The plastic limit is the moisture content at which the soil material changes from semisolid to plastic; the liquid limit is the moisture content at which it changes from plastic to liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of moisture content within which the soil material is in a plastic condition.

test data

procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [1]										Liquid limit	Plasticity index	Classification	
Percentage passing sieve—						Percentage smaller than—						AASHO	Unified
3 in.	¼ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
										Percent			
100	99	94	89	81	52	48	33	19	13	26	9	A-4(3)	CL
100	97	86	79	66	32	29	24	18	16	28	14	A-2-6(1)	SC
100	96	93	90	85	61	58	46	30	22	26	11	A-6(6)	CL
100	99	90	82	60	30	29	22	14	11	29	7	A-2-4(0)	SM-SC
100	90	74	68	43	22	21	19	16	14	38	19	A-2-6(1)	SC
------	100	98	96	92	77	74	63	45	35	34	18	A-6(11)	CL
100	99	97	96	90	53	48	33	18	12	23	6	A-4(4)	ML-CL
100	99	97	95	90	55	51	42	30	25	30	15	A-6(6)	CL
100	99	95	90	84	57	53	41	27	20	25	11	A-6(5)	CL
100	99	97	96	91	57	51	34	18	12	25	8	A-4(4)	CL
------	100	99	97	92	58	55	48	36	30	31	16	A-6(7)	CL
100	99	96	93	87	63	60	52	34	24	27	12	A-6(6)	CL
------	100	99	98	92	35	30	21	13	8	22	6	A-2-4(0)	SM-SC
[2] 97	93	84	80	66	26	24	20	16	16	26	12	A-2-6(0)	SC
100	93	72	61	42	11	10	8	4	3	[3]	[3]	A-1-b(0)	SP-SM
100	96	85	78	60	25	23	18	11	8	23	4	A-2-4(0)	SM-SC
[2] 97	80	61	50	35	19	18	17	14	13	33	17	A-2-6(0)	SC
100	94	66	45	20	8	8	6	4	3	17	4	A-1-a(0)	SW-SM

terial coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

[2] The remaining 3 percent of this sample consisted of fragments more than 3 inches in diameter; these were discarded in field sampling.

[3] Nonplastic.

Estimated engineering properties

In table 6 the soil series and the symbol for each mapping unit are listed and estimates of properties significant in engineering are given. The estimates are for a representative soil, and in general they apply to a depth of 5 feet or less. The estimates are based on available test data and on comparisons with similar soils tested in other counties.

Depth to seasonal high water table is the distance from the surface of the soil to the highest level that ground water reaches in most years. The estimates are for soils that have not been artificially drained. Depth from the surface normally is given only for the major horizons. Other horizons are listed if they have engineering properties significantly different from adjacent horizons. Depth to bedrock, if significant, is given in footnotes. In most of the soils, the depth to bedrock is greater than the depth of sampling in field mapping.

Soil texture is described in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay particles. "Loam," for example, is soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles. If the soil contains gravel or other particles more than 2 millimeters in diameter, an appropriate modifier is added, as for example, "gravelly loam." "Sand," "silt," "clay," and some of the other terms used in USDA textural classification are defined in the Glossary at the end of this survey.

The estimated classification according to the textural classification of the U.S. Department of Agriculture and according to the AASHO and Unified classification systems is given for each important layer.

The figures showing the percentages of material passing through sieves Nos. 4, 10, and 200 are rounded off to the nearest 5 percent. The percentage passing the No. 200 sieve approximates the combined amount of silt and clay in the soil. The percentage of coarse fragments larger than 3 inches in diameter, if significant, is given in footnotes.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of soil characteristics observed in the field, particularly structure and texture. The estimates in table 6 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most plants.

Reaction is the range in acidity or alkalinity of a soil, expressed in pH values. The pH value and equivalent verbal descriptions of reaction are explained in the Glossary.

Shrink-swell potential is the relative change in volume to be expected with changes in the moisture content of the soil material, that is, the extent to which the soil shrinks as it dries out and swells when it becomes wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations roads, and other structures. A high shrink-swell potential is a hazard to maintenance of structures built in, on, or with material having this rating.

Engineering interpretations

Engineering interpretations are given in tables 7 and 8. The data in these tables apply to the profile described as representative of the series in the section "Descriptions of the Soils."

Table 7 gives the suitability of the soils as a source of topsoil, sand, gravel, and road fill, and lists features that affect the use of soils as locations for highways, as foundations for low buildings, and in winter grading. Also given in table 7 are limitations for septic tank disposal fields and ratings for the corrosive potential for conduits.

The ratings for suitability as a source of topsoil were based largely on texture and organic-matter content. Topsoil is soil material, preferably rich in organic matter, that is used to topdress back slopes, embankments, lawns, gardens, and the like. Unless otherwise indicated, only the surface layer was considered in making these ratings.

Ratings of suitability as sources of sand and gravel apply only to material within a depth of 5 feet. Some soils that are rated "not suited" in table 7 may have sand and gravel at a depth of more than 5 feet. In some of the soils, sand and gravel is at a depth of less than 5 feet and extends to a depth greater than 5 feet. Where suitability is questionable, the availability of the sand and gravel can be determined by digging test pits. Soils of the Boyer, Fox, Gilford, Gladwin, Mancelona, Matherton, Newaygo, Sebewa, and Wasepi series have fair to good potential as sources of gravel.

Ratings of the suitability of the soil as a source of road fill are based on performance of soil material used as borrow for subgrade. Both the subsoil and substratum are rated if they have contrasting characteristics. The most suitable material is sand that has enough fines for binding; the least suitable is clay.

Also listed in table 7 are soil features affecting location of highways. The soil features considered were those that affect the overall performance of the soil, such as a high water table or steep slopes. The entire soil profile, undisturbed and without artificial drainage, was evaluated. Good materials for road subbase are well distributed throughout the county in the sandy and gravelly soils (fig. 12). Additional information can be obtained from the State Highway Department of Michigan, which has rated the major soil series in the State for their suitability for highway construction. This information is in the "Field Manual of Soil Engineering" (*2*).

Of special concern to engineers involved with highway locations are the silty soils of the county, particularly the Kibbie and Colwood soils. These soils consist of stratified silt loam, fine sand, and very fine sand that is soft and very unstable and has low bearing capacity and is highly susceptible to frost action.

The soils are also rated in table 7 for suitability for foundations for buildings that are no more than three stories high. The suitability of the soils as a base for low buildings depends mainly on characteristics of the substratum, which generally provides the base for foundations. Ratings are therefore for the substratum. Important factors considered in determining the suitability of the soils as foundations for low buildings are susceptibility to

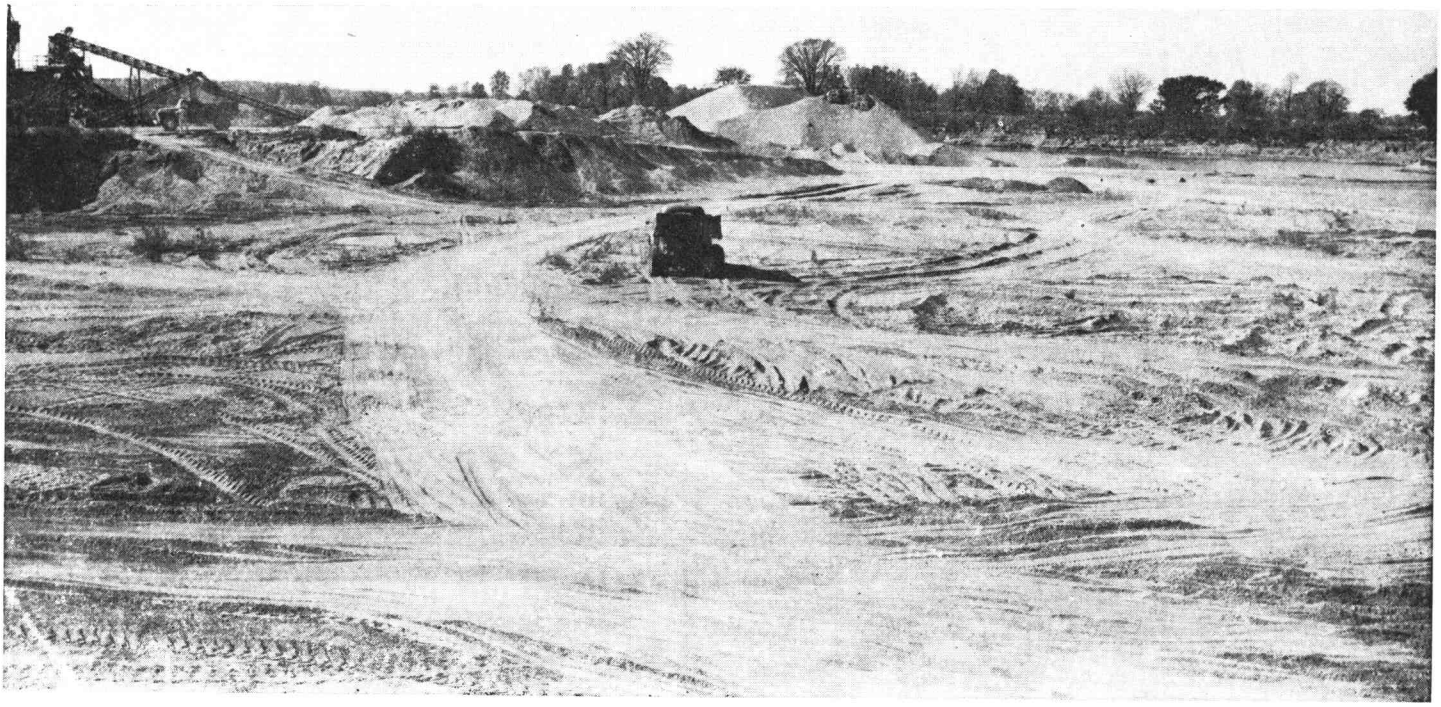

Figure 12.—**Sand and gravel pit in an area of Boyer soils. These soils are sources of base and subbase material for highways.**

frost heave, depth to water table, compressibility, and shrink-swell potential. Engineers and others should not infer specific values from the estimates given.

The poor stability of the Kibbie and Colwood soils is likely to result in cracks in basement walls and settling of foundations, particularly in buildings of more than one story. Frost heave is a relatively serious hazard on the somewhat poorly drained and poorly drained soils, such as the Kibbie, Colwood, and Lenawee soils. Paved sidewalks, driveways, and garage or carport floors on these soils are likely to be damaged by frost heave unless a foot or more of coarse-textured material is placed below the paving.

Among the soil features that affect winter grading are those that, in winter, affect the crossing of areas of soil and the handling of soil material with ordinary construction equipment. Important factors considered are texture of the soil material, natural content of water, and depth to water table.

Limitations of the soils for use as disposal fields for septic tanks and soil features that affect their use for this purpose are also shown in table 7. Some of the limiting factors are permeability, depth to water table, depth to bedrock, flood hazard, and relief. Soils that have somewhat poor or poor drainage, a seasonal high water table, or slow permeability are poor sites. A sewage disposal system does not function properly in such soils. A percolation rate of 60 minutes per inch or less is desirable for a septic tank disposal field. This is equivalent to a permeability rate of 1 inch per hour. Permeability rates for the soils in Shiawassee County are given in table 6.

The soils are also rated in table 7 according to the degree that they encourage the corrosion of conduits in them. Ratings are given for uncoated steel conduits and concrete conduits. The texture and natural drainage of a soil affect this potential through their influence on aeration, content of water, and movement of water. The pH of the soil is also important.

Table 8 lists features that affect the use of the soils for agricultural drainage, irrigation, terraces and diversions, grassed waterways, and farm ponds.

Listed under agricultural drainage are features that affect the installation and performance of surface and subsurface drainage systems. Such features are texture, permeability, relief, restricting layers, and depth of water table. Artificial drainage is needed in areas that have been cleared for farming. Many wet areas in the county that are used for pasture are suited to crops if adequately drained and managed.

The major features affecting suitability of the soils for irrigation are available water capacity and rate of water intake. Also important are relief, the need for drainage, and depth to soil material that restricts growth of roots. Little irrigation is now done in the county, but many of the soils are suitable for irrigation. If irrigated, the large acreage of sandy soils in the county would be suitable for many crops, including many specialty crops. In many areas water for irrigation can be obtained from shallow wells or lakes.

Important features that affect the layout and construction of terraces and diversions are relief, texture of the soil material, and depth to material that restricts growth of roots. Most of the sloping soils on uplands in the county have properties that are suitable for the construction of terraces and diversions. In many places, however, slopes are too irregular for terraces.

The suitability of grassed waterways depends on soil features that affect the construction and maintenance

of the waterways and the growth of plants in them. Important features are fertility, available moisture capacity, rate of surface runoff, and susceptibility to erosion. Establishment of a good, dense sod that is resistant to erosion is needed for well-constructed waterways.

The seepage rate of undisturbed soil material is the most important feature affecting the reservoir area of a farm pond. Features affecting embankments are compaction properties, stability, seepage rate, and the piping hazard. Because of the slow seepage rate, the soils that formed in loam, clay loam, and silty clay loam are favorable for construction of farm ponds. The soils that formed in sandy loam materials have a rapid seepage rate, and this results in wide fluctuations in the water level. Ponds can be constructed on these soils, however, by careful selection of materials from the subsoil for use in blanketing the reservoir area and by compacting the material. The soils that formed in sand and loamy sand have an excessive seepage rate and are not suitable sites for ponds. Springs in many low areas in the county provide a good flow of water. Good ponds can be constructed in these areas, even though the seepage rate is rapid. Careful onsite investigation is needed before constructing the ponds.

Many of the soil features affecting farm ponds are also applicable to sewage lagoons. In addition to these features, relief, depth to the water table, and the organic-matter content are important features affecting sewage

TABLE 6.—*Estimated engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in referring to other series that appear in the first column of this

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Abscota	4+	0–10	Sandy loam	SM
Mapped only with Eel and Landes soils.		10–40	Loamy sand	SM
		40–60	Sand	SP
Algansee: Ah	1–2	0–10	Sandy loam	SM
		10–27	Loamy sand	SM
		27–60	Sand	SP
Barry: Ba, Bc	<1	0–10	Loam	ML
		10–25	Loam	ML
		25–36	Sandy clay loam	SC
		36–60	Sandy loam	SM
Barry, bedrock variant: Bb [4]	<1	0–38	Sandy loam	SM
		38	Sandstone bedrock.	
Belding: BeA	1–2	0–9	Sandy loam	SM
		9–26	Loamy sand and sandy loam	SM
		26–36	Clay loam	CL
		36–60	Loam	ML–CL or CL
Berville: Bh	<1	0–15	Loam	ML
		15–37	Gravelly sandy clay loam and gravelly clay loam.	SC and CL
		37–60	Clay loam	CL
Boyer: BmA, BmB, BmC, BmD, BmE, BoB, BrA, BrB, BrC, BrD.	4+	0–12	Sandy loam or loamy sand	SM
		12–26	Sandy loam	SM
		26–32	Gravelly sandy clay loam	SC
		32–60	Gravelly coarse sand	SP or GP
Breckenridge: Bt	<1	0–20	Sandy loam and loamy sand	SM
		20–30	Sandy loam and sandy clay loam	SM or SC
		30–60	Clay loam	CL
Brevort: Bv	<1	0–18	Loamy sand	SM
		18–28	Sand	SP-SM or SP
		28–60	Clay loam	CL

See footnotes at end of table.

lagoons. Level relief, low water table, and a low organic-matter content are desirable features for lagoons.

Residential Development

Important factors to consider in using the soils for residential development are soil drainage, permeability, stability, and the frequency of flooding. Soils that are somewhat poorly drained or poorly drained, that have a seasonal high water table, or that have slow permeability are poor construction sites for residential use. The limitations of the soils for domestic sewage-disposal systems are described in table 7.

On wet and slowly permeable soils, basements are difficult to keep dry. The best soils in the county for residential use are the well-drained soils that formed in sandy loam and loamy sand material. The most favorable soils are those of the Boyer, Lapeer, Mancelona, and Spinks series. The very sandy, well-drained Plainfield soils, slightly acid variant, are also suited, except for droughtiness. On these soils good lawns and shrubs can be established and maintained if they are watered regularly. Blanketing the areas with a loamy topsoil makes them less droughty.

The Algansee, Ceresco, Cohoctah, Glendora, Shoals, and Sloan soils in the county in the flood plains of streams are severely limited for use as residential developments because of the hazard of flooding.

properties of the soils

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for table. The sign > means more than. The sign < means less than]

Classification—Continued	Percentage less than 3 inches passing sieve—			Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
AASHO	No. 4	No. 10	No. 200				
				Inches per hour	*Inches per inch of soil*	*pH*	
A-2	100	90–100	25–35	2. 0–6. 30	0. 13–0. 15	6. 1–7. 3	Low.
A-2	100	95–100	15–25	6. 30–20. 0	0. 09–0. 11	6. 6–7. 3	Low.
A-3	100	100	0–5	6. 30–20. 0	0. 05–0. 07	7. 4–7. 8	Low.
A-2	100	95–100	20–35	2. 0–6. 30	0. 13–0. 15	6. 1–6. 5	Low.
A-2	100	95–100	15–25	6. 30–20. 0	0. 09–0. 11	6. 6–7. 3	Low.
A-3	90–100	80–100	0–5	6. 30–20. 0	0. 05–0. 07	7. 4–7. 8	Low.
A-4	[3] 95–100	90–100	55–65	0. 63–2. 0	0. 20–0. 22	7. 4–7. 8	Low.
A-4	[3] 95–100	90–100	50–70	0. 63–2. 0	0. 16–0. 19	7. 4–7. 8	Low.
A-6	95–100	90–100	35–50	0. 63–2. 0	0. 15–0. 18	7. 4–7. 8	Low to moderate.
A-2	95–100	90–100	25–35	2. 0–6. 30	0. 11–0. 13	7. 4–8. 0	Low.
A-2 or A-4	[5] 95–100	90–000	25–50	2. 0–6. 30	0. 13–0. 15	5. 6–6. 5	Low.
A-2 or A-4	95–100	95–100	30–50	2. 0–6. 30	0. 11–0. 15	6. 1–7. 3	Low.
A-2	95–100	95–100	15–30	2. 0–6. 30	0. 10–0. 13	5. 6–6. 0	Low.
A-6	95–100	90–100	55–70	0. 20–0. 63	0. 15–0. 17	6. 6–7. 3	Low to moderate.
A-4 or A-6	90–100	90–100	70–80	0. 20–0. 63	0. 16–0. 19	7. 4–8. 0	Low to moderate.
A-4	90–100	70–100	60–70	0. 63–2. 0	0. 17–0. 22	6. 1–6. 3	Low.
A-6	70–100	60–95	45–75	0. 20–0. 63	0. 15–0. 18	7. 4–7. 8	Low to moderate.
A-6	90–95	85–95	60–80	0. 20–0. 63	0. 16–0. 19	7. 4–8. 0	Low to moderate.
A-2	[5] 100	90–100	15–35	2. 0–6. 30	0. 10–0. 15	6. 1–6. 5	Low.
A-2 or A-4	95–100	95–100	25–40	2. 0–6. 30	0. 12–0. 14	5. 6–6. 5	Low.
A-6	70–85	60–80	35–50	0. 63–2. 0	0. 16–0. 18	6. 6–7. 3	Low to moderate.
A-1 or A-3	40–75	35–70	0–5	>20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-2	95–100	90–95	20–35	2. 0–6. 30	0. 11–0. 15	7. 4–7. 8	Low.
A-2 or A-6	95–100	90–95	20–45	2. 0–6. 30	0. 12–0. 18	7. 4–7. 8	Low to moderate.
A-6	90–100	85–95	70–80	0. 20–0. 63	0. 14–0. 16	7. 4–8. 0	Moderate.
A-2	95–100	90–100	20–30	2. 0–6. 30	0. 10–0. 12	6. 6–7. 8	Low.
A-3	95–100	90–100	0–10	6. 30–20. 0	0. 06–0. 08	7. 4–7. 8	Low.
A-6	95–100	80–95	70–80	0. 20–0. 63	0. 14–0. 16	7. 4–8. 0	Moderate.

TABLE 6.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Brookston: Bw	<1	0–13	Loam	ML or CL
		13–42	Clay loam	CL
		42–60	Loam	ML–CL
Carlisle: Cg	0	0–60	Muck and mucky peat	Pt
Celina: ChB, ChB2	2–3	0–15	Loam	ML or CL
		15–30	Clay loam	CL
		30–60	Loam	ML–CL or CL
Ceresco: Cm	1–2	0–7	Loam	ML
		7–34	Sandy loam	SM
		34–60	Sandy loam	SM
Cohoctah: Cn	<1	0–8	Loam	ML
		8–60	Sandy loam	SM
Colwood: Cs	<1	0–19	Loam	ML
		19–38	Sandy clay loam	SC
		38–60	Stratified very fine sand, fine sand, and silt loam.	ML
Conover: CtA, CtB	1–2	0–13	Loam	ML or CL
		13–36	Clay loam	CL
		36–60	Loam	ML–CL or CL
Edwards: Ek	0	0–20	Muck	Pt
		20–42	Marl	
*Eel: En	2–3	0–30	Loam	ML
For Landes and Abscota parts, see Landes and Abscota series.		30–60	Loam	ML
Fox: FoB, FoC, FoD	4+	0–11	Sandy loam	SM
		11–24	Gravelly loam and gravelly clay loam.	CL
		24–36	Gravelly sandy clay loam	SC
		36–60	Gravelly coarse sand	GP or SP
Gilford: Gg, Gh	<1	0–14	Sandy loam	SM
		14–36	Sandy loam	SM
		36–60	Fine gravelly sand	SP–SM or SP
Gladwin: GmA	1–2	0–22	Loamy sand	SM
		22–32	Sandy loam	SM
		32–60	Gravelly sand	SP-SM or SP
Glendora: Gn	<1	0–8	Sandy loam	SM
		8–18	Loamy sand	SM
		18–60	Sand	SP-SM
Granby: Go	<1	0–12	Loamy sand	SM
		12–60	Sand	SP
Gravel pits: Gp. Properties variable; onsite investigation needed.				
Iosco: IsA, ItA	1–2	0–15	Loamy sand	SM
		15–27	Sand	SP-SM or SP
		27–60	Clay loam	CL

See footnotes at end of table.

properties of the soils—Continued

Classification—Continued	Percentage less than 3 inches passing sieve—			Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
AASHO	No. 4	No. 10	No. 200				
				Inches per hour	*Inches per inch of soil*	*pH*	
A-4 or A-6	95–100	95–100	60–70	0. 63–2. 0	0. 20–0. 22	6. 6–7. 3	Low.
A-6	95–100	90–100	70–80	0. 20–0. 63	0. 14–0. 18	7. 4–7. 8	Moderate.
A-4 or A-6	95–100	85–95	60–75	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Low to moderate.
				2. 0–6. 30	0. 25–0. 50	6. 6–7. 3	Variable.
A-4 or A-6	95–100	95–100	60–70	0. 63–2. 0	0. 20–0. 22	6. 1–7. 3	Low.
A-6	95–100	85–95	70–80	0. 20–0. 63	0. 15–0. 19	6. 5–7. 3	Moderate.
A-4 or A-6	95–100	80–95	60–80	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Low to moderate.
A-4	100	95–100	55–70	0. 63–2. 0	0. 16–0. 19	7. 4–7. 8	Low.
A-2	100	90–100	25–35	2. 0–6. 30	0. 12–0. 14	7. 4–7. 8	Low.
A-2	95–100	95–100	20–30	2. 0–6. 30	0. 10–0. 13	7. 4–8. 0	Low.
A-4	100	95–100	55–65	0. 63–2. 0	0. 20–0. 22	6. 1–6. 5	Low.
A-2	95–100	90–100	15–35	2. 0–6. 30	0. 12–0. 14	6. 6–7. 8	Low.
A-4	100	95–100	60–70	0. 63–2. 0	0. 16–0. 19	6. 6–7. 8	Low.
A-4	95–100	90–100	35–50	0. 63–2. 0	0. 15–0. 17	6. 6–7. 3	Low to moderate.
A-4	100	95–100	60–75	0. 63–2. 0	0. 12–0. 16	7. 4–8. 0	Low.
A-4 or A-6	[3] 95–100	95–100	55–70	0. 63–2. 0	0. 20–0. 22	6. 6–7. 3	Low.
A-6	95–100	85–95	70–80	0. 20–0. 63	0. 15–0. 19	6. 1–6. 5	Moderate.
A-4 or A-6	95–100	85–95	60–80	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Low to moderate.
				2. 0–6. 30	0. 25–0. 50	7. 4–7. 8	Variable.
				Variable	Variable	7. 4–8. 0	Variable.
A-4	95–100	90–100	55–70	0. 63–2. 0	0. 20–0. 22	6. 1–7. 3	Low.
A-4	100	95–100	60–75	0. 63–2. 0	0. 15–0. 19	7. 4–7. 8	Low.
A-2 or A-4	[3] 95–100	90–100	30–50	2. 0–6. 30	0. 13–0. 15	6. 1–6. 5	Low.
A-4 or A-6	80–95	70–85	55–75	0. 63–2. 0	0. 14–0. 18	5. 6–6. 6	Low to moderate.
A-6	80–90	60–85	40–50	0. 63–2. 0	0. 13–0. 18	7. 4–7. 8	Low to moderate.
A-1 or A-3	35–80	25–75	0–5	>20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-2	[3] 95–100	90–100	20–30	2. 0–6. 30	0. 13–0. 17	6. 6–7. 3	Low.
A-2	95–100	90–100	20–35	2. 0–6. 30	0. 12–0. 14	7. 4–7. 8	Low.
A-1 or A-3	55–80	45–70	0–10	0. 30–20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-2	95–100	90–100	15–25	6. 30–20. 0	0. 10–0. 12	6. 1–6. 5	Low.
A-2	95–100	75–100	20–35	2. 0–6. 30	0. 12–0. 14	6. 6–7. 3	Low.
A-1 or A-3	55–80	45–70	0–10	6. 30–20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-2	95–100	90–100	15–35	2. 0–6. 30	0. 13–0. 15	6. 1–6. 5	Low.
A-2	100	100	10–35	6. 30–20. 0	0. 09–0. 11	7. 4–7. 8	Low.
A-3	100	95–100	5–10	6. 30–20. 0	0. 05–0. 07	7. 4–8. 0	Low.
A-2	95–100	90–100	15–25	6. 30–20. 0	0. 10–0. 12	6. 6–7. 3	Low.
A-3	100	95–100	0–5	6. 30–20. 0	0. 05–0. 07	7. 4–7. 8	Low.
A-2	[3] 95–100	90–100	15–25	6. 30–20. 0	0. 10–0. 12	5. 6–6. 0	Low.
A-3	95–100	95–100	0–10	6. 30–20. 0	0. 06–0. 08	5. 6–6. 5	Low.
A-4 or A-6	95–100	85–100	60–80	0. 20–0. 63	0. 14–0. 16	7. 4–8. 0	Moderate.

TABLE 6.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Iosco, deep variant: Iv	1–2	0–32	Loamy sand	SM
		32–44	Coarse gravelly sandy clay loam and gravelly loam.	SC or CL
		44–50	Gravelly sand	SP-SM
		50–66	Loam	ML-CL or CL
Kendallville: KhB, KhB2, KhC, KhC2	4+	0–12	Sandy loam	SM
		12–20	Sandy clay loam	SC
		20–33	Gravelly clay loam	CL
		33–60	Loam and clay loam	ML-CL or CL
Kibbie: KnA, KnB	1–2	0–11	Loam	ML
		11–16	Fine sandy loam	SM
		16–26	Loam	CL
		26–60	Stratified silt loam and fine sand.	ML
Landes Mapped only with Eel and Abscota soils.	4+	0–60	Sandy loam	SM
Lapeer: LmB, LmC2	4+	0–17	Sandy loam	SM
		17–36	Sandy clay loam	SC or CL
		36–60	Sandy loam	SM
Lenawee: Ln	<1	0–14	Silt loam	ML
		14–25	Silty clay loam	CL
		25–60	Stratified silty clay loam and clay loam with thin layers of silt loam, sandy loam, and clay.	CL
Linwood: Lo	0	0–32	Muck	Pt
		32–60	Clay loam	CL
Locke: LsA, LsB	1–2	0–16	Sandy loam	SM
		16–30	Sandy clay loam	SC
		30–60	Sandy loam	SM
Macomb: MaA, MbB	1–2	0–16	Sandy loam and loam	SM, SM-SC, or CL
		16–33	Gravelly sandy clay loam and clay loam.	SC or CL
		33–60	Loam	CL
Made land: Md. Properties variable; onsite investigation needed.				
Mancelona: MeA, MeB	4+	0–20	Loamy sand	SM
		20–28	Sandy loam	SM
		28–60	Gravelly coarse sand	GP or SP
Matherton: MmA, MmB, MnA,[6] MnB[6]	1–2	0–11	Sandy loam	SM
		11–19	Sandy clay loam	SC
		19–35	Gravelly clay loam	CL
		35–60	Very gravelly coarse sand	GP or SP
Menominee: MoB, MoC	3+	0–24	Loamy sand	SM
		24–28	Gravelly sandy clay loam	SC
		28–60	Clay loam	CL

See footnotes at end of table

properties of the soils—Continued

Classification—Continued	Percentage less than 3 inches passing sieve—			Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
AASHO	No. 4	No. 10	No. 200				
				Inches per hour	*Inches per inch of soil*	*pH*	
A-2	95–100	95–100	15–25	6. 30–20. 0	0. 10–0. 12	5. 1–7. 3	Low.
A-4 or A-6	70–95	65–100	40–60	0. 63–2. 0	0. 14–0. 17	7. 4–7. 8	Low to moderate.
A-3	50–80	45–70	5–10	6. 30–20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-4 or A-6	[3] 90–100	85–100	60–80	0. 20–0. 63	0. 17–0. 19	7. 4–8. 0	Low to moderate.
A-2	95–100	90–100	15–35	2. 0–6. 30	0. 13–0. 15	5. 6–6. 0	Low.
A-6	95–100	85–100	35–50	0. 63–2. 0	0. 12–0. 14	6. 1–6. 5	Low to moderate.
A-6	70–95	65–95	70–80	0. 20–0. 63	0. 15–0. 19	6. 6–7. 3	Moderate.
A-4 or A-6	[3] 95–100	90–100	60–80	0. 20–0. 63	0. 17–0. 19	7. 4–8. 0	Low to moderate.
A-4	100	90–100	60–80	0. 63–2. 0	0. 20–0. 22	6. 1–7. 3	Low.
A-4	100	90–100	35–50	0. 63–2. 0	0. 15–0. 18	6. 6–7. 3	Low.
A-6	95–100	90–100	60–80	0. 63–2. 0	0. 16–0. 19	6. 6–7. 3	Low to moderate.
A-4	100	90–100	55–70	0. 63–2. 0	0. 17–0. 19	7. 4–8. 0	Low.
A-2	90–100	90–100	20–35	2. 0–6. 30	0. 10–0. 15	6. 1–7. 8	Low.
A-2 or A-4	90–95	85–95	30–50	2. 0–6. 30	0. 13–0. 15	5. 6–6. 0	Low.
A-6	95–100	85–95	40–60	0. 63–2. 0	0. 15–0. 17	6. 1–7. 8	Low to moderate.
A-2	90–95	80–95	20–35	2. 0–6. 30	0. 11–0. 13	7. 4–8. 0	Low.
A-4	100	95–100	70–80	0. 63–2. 0	0. 20–0. 24	6. 6–7. 3	Low.
A-6 or A-7	100	95–100	80–95	0. 20–0. 63	0. 15–0. 18	7. 4–7. 8	Moderate.
A-6 or A-7	100	95–100	80–90	0. 20–0. 63	0. 14–0. 20	7. 4–8. 0	Moderate.
				2. 0–6. 30	0. 25–0. 50	6. 1–6. 5	Variable.
A-6	95–100	90–100	60–80	0. 63–2. 0	0. 15–0. 17	7. 4–8. 0	Moderate.
A-2 or A-4	95–100	90–100	30–50	2. 0–6. 30	0. 12–0. 15	6. 1–6. 5	Low.
A-6	95–100	85–95	35–50	0. 63–2. 0	0. 16–0. 18	6. 1–6. 5	Low to moderate.
A-2 or A-4	90–95	75–95	30–50	2. 0–6. 30	0. 11–0. 13	7. 4–8. 0	Low.
A-2 or A-4	[3] 95–100	90–100	30–75	0. 63–6. 30	0. 13–0. 19	6. 1–6. 5	Low.
A-2 or A-6	70–95	65–95	20–60	0. 20–0. 63	0. 14–0. 19	6. 1–7. 3	Moderate.
A-6	95–100	85–95	60–80	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Low to moderate.
A-2	[3]95–100	85–100	15–25	6. 30–20. 0	0. 10–0. 12	5. 6–7. 3	Low.
A-2	90–95	60–85	20–35	2. 0–6. 30	0. 12–0. 14	6. 6–7. 3	Low.
A-1 or A-3	20–75	15–75	0–5	>20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-2 or A-4	[3]95–100	90–100	30–50	2. 0–6. 30	0. 13–0. 15	6. 1–6. 5	Low.
A-6	95–100	90–100	35–50	0. 63–2. 0	0. 16–0. 18	6. 1–6. 5	Low to moderate.
A-6	80–90	70–85	65–80	0. 63–2. 0	0. 14–0. 18	6. 6–7. 3	Moderate.
A-1	20–75	15–75	0–5	>20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A-2	100	70–100	15–25	6. 30–20. 0	0. 09–0. 12	5. 1–6. 5	Low.
A-6	[3] 70–95	80–95	35–50	0. 20–0. 63	0. 15–0. 19	7. 4–7. 8	Low to moderate.
A-6	95–100	85–95	70–85	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Moderate.

TABLE 6.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification	
			USDA texture	Unified
	Feet	*Inches*		
Metamora: MrA, MsA, MsB	1–2	0–28	Sandy loam	SM
		28–36	Clay loam	CL
		36–60	Loam	ML or CL
Miami: MuB, MuB2, MuC, MuC2, MuD2, MuE2, MvD3	4+	0–11	Loam	ML-CL or CL
		11–30	Clay loam	CL
		30–60	Loam	ML-CL, CL
Mine pits: Mw. Properties variable; onsite investigation needed.				
Newaygo: NyB	4+	0–18	Sandy loam	SM
		18–34	Sandy clay loam and loam	SC or CL
		34–60	Gravelly coarse sand	GP or SP
Ottokee: OkA	2–3	0–50	Layers of loamy sand and sand	SM or SP–SM
		50–60	Sand	SP
*Owosso: OmB, OmC, OmD2. For Miami part, see Miami series.	4+	0–30	Sandy loam	SM
		30–38	Clay loam	CL
		38–60	Loam	ML–CL
Plainfield, slightly acid variant: PfB, PfC	4+	0–8	Loamy sand	SM
		8–60	Sand	SP
Richter: RhA	1–2	0–13	Loamy fine sand and sandy loam.	SM
		13–18	Loamy sand	SM
		18–26	Sandy loam	SM
		26–60	Stratified sandy loam, loamy sand, and loamy fine sand.	SM
Sebewa: Sd	<1	0–11	Loam	ML
		11–30	Clay loam and gravelly clay loam.	CL
		30–60	Very gravelly coarse sand	GP or SP
Shoals: Sh	1–2	0–14	Loam	ML
		14–60	Loam	ML
Sloan: Sn	<1	0–12	Loam	ML
		12–60	Loam	ML
Spinks: SpA, SpB, SpC, SpD	4+	0–8	Loamy sand	SM
		8–29	Sand	SP–SM or SP
		29–44	Layers of heavy loamy sand and sand.	SM or SP–SM
		44–60	Sand	SP–SM or SP
Tawas: Ta	0	0–31	Muck and mucky peat	Pt
		31–60	Sand	SP or SP–SM
Tuscola: TsB	2–3	0–8	Loam	ML
		8–34	Very fine sandy loam or silt loam.	ML
		34–60	Stratified silt loam, very fine sand, and fine sand.	ML
Wallkill: Wa	<1	0–20	Loam and clay loam	ML or CL
		20–60	Muck	Pt

See footnotes at end of table.

properties of the soils—Continued

Classification—Continued	Percentage less than 3 inches passing sieve—			Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
AASHO	No. 4	No. 10	No. 200				
				Inches per hour	*Inches per inch of soil*	*pH*	
A–2	95–100	90–100	25–35	2. 0–6. 30	0. 13–0. 15	6. 1–7. 3	Low.
A–6	95–100	80–95	65–80	0. 20–0. 63	0. 15–0. 19	6. 6–7. 3	Moderate.
A–4 or A–6	95–100	80–95	60–80	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Low to moderate.
A–4	[3] 95–100	90–100	50–75	0. 63–2. 0	0. 20–0. 22	5. 6–6. 5	Low.
A–6	95–100	85–95	50–80	0. 63–2. 0	0. 15–0. 19	5. 6–7. 3	Moderate.
A–4 or A–6	90–95	85–95	55–80	0. 63–2. 0	0. 15–0. 19	7. 4–8. 0	Low to moderate.
A–2 or A–4	90–100	80–100	25–50	2. 0–6. 30	0. 13–0. 15	6. 1–6. 5	Low.
A–6	95–100	70–100	40–65	0. 63–2. 0	0. 16–0. 18	6. 1–7. 3	Low to moderate.
A–1	25–80	15–75	0–5	6. 30–20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A–2 or A–3	95–100	90–100	5–25	6. 30–20. 0	0. 06–0. 10	6. 1–7. 3	Low.
A–3	100	90–100	0–5	6. 30–20. 0	0. 05–0. 07	7. 4–7. 8	Low.
A–2	95–100	90–95	20–35	2. 0–6. 30	0. 12–0. 15	6. 1–6. 5	Low.
A–6	90–100	95–100	70–80	0. 20–0. 63	0. 15–0. 19	6. 6–7. 3	Moderate.
A–4	90–100	80–95	55–80	0. 20–0. 63	0. 15–0. 19	7. 4–8. 0	Low to moderate.
A–2	100	95–100	10–20	6. 30–20. 0	0. 10–0. 12	6. 1–6. 5	Low.
A–3	100	95–100	0–5	6. 30–20. 0	0. 05–0. 07	6. 1–7. 8	Low.
A–2 or A–4	95–100	90–100	25–50	2. 0–6. 30	0. 13–0. 15	6. 6–7. 3	Low.
A–2	95–100	95–100	15–25	6. 30–20. 0	0. 09–0. 11	6. 6–7. 3	Low.
A–2 or A–4	95–100	95–100	30–50	2. 0–6. 30	0. 13–0. 15	7. 4–7. 8	Low.
A–4	100	95–100	40–50	2. 0–6. 30	0. 10–0. 14	7. 4–8. 0	Low.
A–4	[3] 95–100	90–100	60–70	2. 0–6. 30	0. 20–0. 22	6. 6–7. 3	Low.
A–6	90–95	65–90	55–80	0. 63–2. 0	0. 14–0. 19	7. 4–7. 8	Moderate.
A–1	[3] 25–80	15–75	0–5	>20. 0	0. 02–0. 04	7. 4–8. 0	Low.
A–4	95–100	90–100	70–80	0. 63–2. 0	0. 17–0. 22	6. 6–7. 8	Low.
A–4	95–100	90–100	55–70	0. 63–2. 0	0. 15–0. 19	7. 4–7. 8	Low.
A–4	95–100	90–100	70–80	0. 63–2. 0	0. 20–0. 22	6. 1–7. 3	Low.
A–4	95–100	90–100	60–70	0. 63–2. 0	0. 17–0. 19	6. 6–7. 8	Low.
A–2	100	95–100	15–25	6. 30–20. 0	0. 10–0. 12	6. 1–6. 5	Low.
A–3	100	90–100	0–10	6. 30–20. 0	0. 06–0. 08	6. 1–6. 5	Low.
A–2 or A–3	100	95–100	5–25	2. 0–6. 30	0. 06–0. 11	6. 1–6. 5	Low.
A–3	100	95–100	0–10	6. 30–20. 0	0. 05–0. 07	7. 4–7. 8	Low.
A–3	95–100	90–100	0–10	2. 0–6. 30 6. 30–20. 0	0. 25–0. 50 0. 05–0. 07	6. 1–7. 3 7. 4–8. 0	Variable. Low.
A–4	95–100	90–100	70–80	0. 63–2. 0	0. 20–0. 22	6. 1–6. 6	Low.
A–4	95–100	90–100	50–80	0. 63–2. 0	0. 17–0. 21	6. 1–7. 8	Low.
A–4	100	95–100	50–75	0. 63–2. 0	0. 11–0. 13	7. 4–8. 0	Low.
A–4 or A–6	95–100	90–100	60–70	0. 63–2. 0 2. 0–6. 30	0. 17–0. 22 0. 25–0. 50	6. 1–7. 3 7. 4–7. 8	Low to moderate. Variable.

TABLE 6.—*Estimated engineering*

Soil series and map symbols	Depth to seasonal high water table	Depth from surface [1]	Classification	
			USDA texture	Unified
Wasepi: WeA, WeB	1–2	0–18	Sandy loam	SM–SC or SM
		18–27	Gravelly sandy clay loam	SC
		27–33	Sandy loam	SM
		33–60	Fine gravelly coarse sand	SP–SM or SW–SM

[1] In a representative profile of the soil in Shiawassee County. Variations are common.
[2] With the exception of the marl layer in the Edwards soil, all layers that have a pH value of 7.4 to 8.0 are slightly effervescent. The marl is violently effervescent.
[3] Coarse fraction, greater than 3 inches in diameter, is as much as 5 percent in some areas.

TABLE 7.—*Engineering interpretations for*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils for referring to other series that

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Abscota Mapped only with Eel and Landes soils.	Fair: loamy; moderate organic-matter content; friable.	Good: few fine layers in some areas.	Not suitable	Fair: good if soil binder is added; fair stability and workability.
Algansee: Ah	Fair: loamy; moderate organic-matter content; friable.	Fair: some fines	Not suitable	Fair: good if soil binder is added; fair stability and workability; somewhat poor drainage.
Barry: Ba, Bc	Ba unit, good: loamy; high organic-matter content; friable; poor drainage. Bc unit, poor: stony.	Not suitable	Not suitable	Fair in Ba unit: fair stability; fair to good workability; poor drainage. Bc unit, poor: stony.
Barry, bedrock variant: Bb	Good: loamy; moderate organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Poor: sandstone bedrock at depth of 24 to 40 inches.
Belding: BeA	Fair: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Fair: fair stability; fair to good workability; low to moderate shrink-swell potential; somewhat poor drainage.

properties of the soils—Continued

Classification—Continued	Percentage less than 3 inches passing sieve—			Permeability	Available water capacity	Reaction [2]	Shrink-swell potential
AASHO	No. 4	No. 10	No. 200				
A–2 or A–4	[3] 90–100	85–95	15–40	2. 0–6. 30	0. 13–0. 15	6. 6–7. 3	Low.
A–2 or A–6	[3] 80–95	70–95	25–50	2. 0–6. 30	0. 14–0. 17	6. 1–6. 5	Low.
A–2	95–100	70–95	15–30	2. 0–6. 30	0. 12–0. 14	6. 6–7. 3	Low.
A–1	55–80	45–70	5–12	>20. 0	0. 02–0. 04	7. 4–8. 0	Low.

[4] Sandstone bedrock within 24 to 40 inches of surface.
[5] Coarse fraction, greater than 3 inches in diameter, is 5 to 20 percent in some areas.
[6] MnA and MnB units are underlain by loam and clay loam at a depth of 42 to 66 inches.

roadbuilding and community development

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
Flood hazard	Good drainage; slight compressibility; good shear strength.	Sandy texture; low moisture content; good stability on thawing.	Moderate: flood hazard; rapid permeability; possible contamination of shallow water supplies.	Low	Low.
Seasonal high water table; flood hazard.	Somewhat poor drainage; seasonal high water table; slight compressibility; good shear strength.	Sandy texture; seasonal high water table; wet conditions hinder operations in some areas; good stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; flood hazard; rapid permeability.	Low	Low.
High water table; Bc unit is stony.	Poor drainage; high water table; slight compressibility; fair shear strength.	Loamy texture; high water table; wet conditions hinder operations; fair stability on thawing. Bc unit, stony.	Severe: poor drainage; high water table; moderate permeability; Bc unit, stony.	High	Low.
High water table; sandstone bedrock at depth of 24 to 40 inches.	Poor drainage; high water table; sandstone bedrock at depth of 24 to 40 inches.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing; sandstone bedrock at depth of 24 to 40 inches.	Severe: poor drainage; high water table; moderate permeability; sandstone bedrock at depth of 24 to 40 inches.	High	Low.
Seasonal high water table; low to moderate shrink-swell potential.	Somewhat poor drainage; seasonal high water table; low to moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; seasonal high water table; wet conditions hinder operations in some areas; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high table; moderately slow permeability in underlying loamy material.	High	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Berville: Bh	Good: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Fair: fair stability and workability; low to moderate shrink-swell potential; poor drainage.
Boyer: BmA, BmB, BmC, BmD, BmE, BoB. BrA, BrB, BrC, BrD.	Poor: loamy and sandy; some hilly areas; BoB unit, stony; low organic-matter content; friable.	Good: some fines and gravel.	Fair: sandy; some fines.	Good: fair stability; good workability; BoB unit, poor: stony.
Breckenridge: Bt	Good: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Fair: fair stability and workability; low to moderate shrink-swell potential; poor drainage.
Brevort: Bv	Poor: sandy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Fair: fair stability and workability; low to moderate shrink-swell potential; poor drainage.
Brookston: Bw	Good: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Fair: poor to fair stability; fair workability; low to moderate shrink-swell potential; poor drainage.
Carlisle: Cg	Poor: organic material; fair to good if mixed with mineral material; friable; very poor drainage.	Not suitable	Not suitable	Not suitable: organic material; very poor drainage.
Celina: ChB, ChB2	Fair in ChB: loamy; moderate organic-matter content; friable. ChB2 unit, poor: moderately eroded.	Not suitable	Not suitable	Fair: poor to fair stability; fair workability; low to moderate shrink-swell potential.
Ceresco: Cm	Poor: loamy; moderate organic-matter content; thin, less than 8 inches; very friable.	Not suitable	Not suitable	Fair: good stability; fair workability; somewhat poor drainage.

roadbuilding and community development—Continued

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
High water table; low to moderate shrink-swell potential.	Poor drainage; high water table; low to moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: poor drainage; high water table; moderately slow permeability.	High	Low.
Cuts and fills needed in some areas; BoB unit, stony.	Good drainage; slight compressibility; good shear strength.	Loamy and sandy texture; low moisture content; good stability on thawing; BoB unit, stony.	Slight on 0 to 12 percent slopes: moderately rapid permeability; possible contamination of shallow water supplies. Moderate on 12 to 18 percent slopes: installation and operations of disposal fields are difficult on slopes of more than 12 percent. Severe on BoB unit: stones hinder installation.	Low	Low.
High water table; low to moderate shrink-swell potential.	Poor drainage; high water table; moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; high water table; wet conditions hinder operations; fair stability on thawing.	Severe: poor drainage; high water table; moderately slow permeability in underlying loamy material.	High	Low.
High water table; low to moderate shrink-swell potential.	Poor drainage; high water table; moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; high water table; wet conditions hinder operations; fair stability on thawing.	Severe: poor drainage; high water table; moderately slow permeability in underlying loamy material.	High	Low.
High water table; poor to fair stability; low to moderate shrink-swell potential.	Poor drainage; high water table; low to moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: poor drainage; high water table; moderately slow permeability.	High	Low.
High water table; poor stability; organic material must be removed.	Very poor drainage; high water table; high compressibility; poor shear strength; poor stability.	Organic material; high water table; wet conditions hinder operations; very poor stability on thawing.	Severe: very poor drainage; high water table; moderately rapid permeability; unstable organic material.	High	Moderate.
Poor to fair stability; low to moderate shrink-swell potential.	Moderately good drainage; low to moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; fair stability on thawing.	Moderate to severe: seep areas and wet depressions; moderately slow permeability.	Moderate	Low.
Seasonal high water table; flood hazard.	Somewhat poor drainage; seasonal high water table; slight compressibility; fair shear strength.	Loamy texture; seasonal high water table; wet conditions hinder operations; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately rapid permeability; flood hazard.	Moderate	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Cohoctah: Cn	Fair: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Fair: good stability; fair workability; poor drainage.
Colwood: Cs	Good: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Poor: poor stability; fair workability; high susceptibility to frost action; low to moderate shrink-swell potential; poor drainage.
Conover: CtA, CtB	Fair: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Fair: poor to fair stability; fair workability; low to moderate shrink-swell potential; somewhat poor drainage.
Edwards: Ek	Poor: organic material. Fair to good if mixed with mineral material; friable; very poor drainage.	Not suitable	Not suitable	Not suitable: organic material and marl; very poor drainage.
*Eel: En For Landes and Abscota parts, see Landes and Abscota series.	Fair: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Poor: poor stability; fair workability; high susceptibility to frost action.
Fox: FoB, FoC, FoD	Fair: loamy; moderate organic-matter content; friable; hilly in some areas and cobblestones in those areas.	Fair: some fines and gravel.	Fair to good: sandy; some fines.	Good: stability and workability; cobblestones in some areas.
Gilford: Gg, Gh	Fair in Gg: loamy; high organic-matter content; friable; poor drainage; cobblestones in some areas. Gh unit, poor: stony.	Good: some fines and gravel.	Fair: sandy; some fines.	Fair in Gg: fair stability and workability; cobblestones in some areas; poor drainage. Gh unit, poor: stony.
Gladwin: GmA	Poor: sandy; low organic-matter content; very friable.	Good: some fines and gravel.	Fair: sandy; some fines.	Fair: fair stability and workability; somewhat poor drainage.

roadbuilding and community development—Continued

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
High water table; flood hazard.	Poor drainage; high water table; slight compressibility; fair shear strength.	Loamy texture; high water table; wet conditions hinder operations; fair stability on thawing.	Severe: poor drainage; high water table; flood hazard; moderately rapid permeability.	Moderate	Low.
High water table; poor stability; high susceptibility to frost action.	Poor drainage; high water table; medium compressibility; poor shear strength; high susceptibility to frost action.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: poor drainage; high water table; moderate permeability; fine soil material clogs tile in places.	High	Low.
Seasonal high water table; poor to fair stability; low to moderate shrink-swell potential.	Somewhat poor drainage; seasonal high water table; low to moderate shrink-swell potential; medium compressibility; low to moderate shear strength.	Loamy texture; seasonal high water table; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately slow permeability.	High	Low.
High water table; poor stability; organic material and marl must be removed.	Very poor drainage; high water table; high compressibility; poor shear strength; poor stability.	Organic material and marl; high water table; wet conditions hinder operations; very poor stability on thawing.	Severe: very poor drainage; high water table; moderately rapid permeability in organic material; variable permeability in marl; unstable organic material.	High	Low.
Poor stability; high susceptibility to frost action.	Moderately good drainage; medium compressibility; poor shear strength.	Loamy texture; poor stability on thawing.	Moderate: flood hazard; moderate permeability.	Low	Low.
Cuts and fills needed in some areas; cobblestones in some areas.	Good drainage; slight compressibility; good shear strength.	Loamy texture; good stability on thawing; cobblestones in some areas.	Slight on 2 to 12 percent slopes: moderate permeability; possible contamination of shallow water supplies. Moderate on 12 to 18 percent slopes: installation and operation of disposal fields are difficult on slopes of more than 12 percent.	Low	Low.
High water table; cobblestones in some areas; Gh unit is stony.	Poor drainage; high water table; slight compressibility; good shear strength.	Loamy texture; high water table; wet conditions hinder operations; fair stability on thawing; cobblestones in some areas; Gh unit is stony.	Severe: poor drainage; high water table; moderately rapid permeability; Gh unit is stony.	High	Low.
Seasonal high water table.	Somewhat poor drainage; seasonal high water table; slight compressibility; good shear strength.	Sandy texture; seasonal high water table; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately rapid permeability.	Moderate	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Glendora: Gn	Poor: loamy; moderate organic-matter content; very friable; poor drainage.	Fair: some fines.	Not suitable	Fair: fair stability and workability; poor drainage.
Granby: Go	Poor: sandy; high organic-matter content; very friable; poor drainage.	Good	Not suitable	Fair: poor to fair stability; fair workability; poor drainage.
Gravel pits: Gp. Properties variable; onsite investigation needed.				
Iosco: IsA, ItA	Poor: sandy; low organic-matter content; very friable; cobblestones in some areas. ItA unit is stony.	Fair: limited source of sandy material to a depth ranging from 18 to 42 inches.	Not suitable	IsA unit, fair: fair stability and workability; low to moderate shrink-swell potential; somewhat poor drainage; cobblestones in some areas. ItA unit, poor: stony.
Iosco, deep variant: Iv	Poor: sandy; low organic-matter content; very friable.	Fair: limited source of sandy material to a depth ranging from 18 to 42 inches.	Not suitable	Fair: fair stability and workability; low to moderate shrink-swell potential; somewhat poor drainage.
Kendallville: KhB, KhB2, KhC, KhC2	Fair in KhB and KhC: loamy; moderate organic-matter content; friable; KhB2 and KhC2 units, poor: moderately eroded.	Not suitable	Not suitable	Good: fair stability; good workability; low to moderate shrink-swell potential.
Kibbie: KnA, KnB	Good: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Poor: poor stability; fair workability; high susceptibility to frost action; somewhat poor drainage.
Landes. Mapped only with Eel and Abscota soils.	Poor: loamy; moderate organic-matter content; friable; thin, less than 8 inches.	Not suitable	Not suitable	Fair: fair stability and workability.
Lapeer: LmB, LmC2	Fair in LmB: loamy; moderate organic-matter content; friable. LmC2 unit, poor: moderately eroded.	Not suitable	Not suitable	Fair: fair stability; fair to good workability.

roadbuilding and community development—Continued

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
High water table; flood hazard.	Poor drainage; high water table; slight compressibility; fair to good shear strength.	Loamy texture; high water table; wet conditions hinder operations; fair stability on thawing.	Severe: poor drainage; high water table; flood hazard; rapid permeability.	High	Low.
High water table; loose sand hinders operations in many areas.	Poor drainage; high water table; slight compressibility; good shear strength.	Sandy texture; high water table; wet conditions hinder operations; fair stability on thawing.	Severe: poor drainage; high water table; rapid permeability.	High	Low.
Seasonal high water table; low to moderate shrink-swell potential; ItA unit is stony.	Somewhat poor drainage; seasonal high water table; moderate shrink-swell potential; fair shear strength.	Sandy texture; seasonal high water table; wet conditions hinder operations; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; rapid permeability in sandy subsoil; moderately slow permeability in lower part of loamy subsoil and underlying material; stones hinder installation on ItA unit.	High	Low.
Seasonal high water table; low to moderate shrink-swell potential.	Somewhat poor drainage; seasonal high water table; low to moderate shrink-swell potential; slight to medium compressibility; poor to fair shear strength.	Sandy texture; seasonal high water table; wet conditions hinder operations; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; rapid permeability in upper part of sandy subsoil; moderately slow permeability in lower loamy subsoil.	High	Low.
Cuts and fills needed in a few areas; low to moderate shrink-swell potential.	Good drainage; low to moderate shrink-swell potential; medium compressibility; fair shear strength.	Loamy texture; good stability on thawing.	Moderate to severe: seep areas and wet depressions in some areas; moderate permeability and moderately slow permeability.	Low	Low.
Seasonal high water table; poor stability; high susceptibility to frost action.	Somewhat poor drainage; seasonal high water table; medium compressibility; poor shear strength; high susceptibility to frost action.	Loamy texture; seasonal high water table; poor stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderate permeability; fine soil material clogs tile lines in places.	Moderate	Low.
Flood hazard	Good drainage; slight compressibility; fair shear strength.	Loamy texture; good stability on thawing.	Moderate: flood hazard; moderately rapid permeability.	Low	Low.
Cuts and fills needed in a few areas.	Good drainage; slight compressibility; fair shear strength.	Loamy texture; good stability on thawing.	Slight: moderate permeability.	Low	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Lenawee: Ln	Good: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Poor: poor to fair stability and workability; high susceptibility to frost action; moderate shrink-swell potential; poor drainage.
Linwood: Lo	Poor: organic material; fair to good if mixed with mineral material; friable; very poor drainage.	Not suitable	Not suitable	Not suitable for upper organic layers: poor stability; high compressibility. Fair for underlying loamy material: fair stability and workability; moderate shrink-swell potential; very poor drainage.
Locke: LsA, LsB	Fair: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Fair: fair stability; fair to good workability; somewhat poor drainage.
Macomb: MaA, MbB	Fair to good: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Fair: fair stability; fair to good workability; low to moderate shrink-swell potential; somewhat poor drainage.
Made land: Md. Properties variable; onsite investigation needed.				
Mancelona: MeA, MeB	Poor: sandy; low organic-matter content; very friable.	Good: some fines and gravel.	Good: sandy; some fines.	Good: fair stability; fair to good workability.
Matherton: MmA, MmB, MnA, MnB	Fair: loamy; moderate organic-matter content; friable.	Fair for underlying material; some gravel.	Fair for underlying material; sandy.	Fair: fair stability; low to moderate shrink-swell potential; somewhat poor drainage.
Menominee: MoB, MoC	Poor: sandy; low organic-matter content; very friable.	Fair: limited source of sandy material to a depth ranging from 18 to 42 inches.	Not suitable	Fair: fair stability and workability; low to moderate shrink-swell potential.
Metamora: MrA, MsA, MsB	Poor to fair: sandy and loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Fair: poor to fair stability; fair workability; low to moderate shrink-swell potential; somewhat poor drainage.

roadbuilding and community development—Continued

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
High water table; poor to fair stability; high susceptibility to frost action; moderate shrink-swell potential.	Poor drainage; high water table; moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength; high susceptibility to frost action.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: poor drainage; high water table; moderately slow permeability.	High	Low.
High water table; poor stability; organic material must be removed.	Very poor drainage; high water table; moderate shrink-swell potential; medium compressibility; fair shear strength.	Organic material; high water table; wet conditions hinder operations; very poor stability on thawing.	Severe: very poor drainage; high water table; moderately rapid permeability in organic material; moderate permeability in underlying material; unstable organic material.	High	Low.
Seasonal high water table.	Somewhat poor drainage; seasonal high water table; slight compressibility; fair shear strength.	Loamy texture; seasonal high water table; wet conditions hinder operations; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderate permeability.	Moderate	Low.
Seasonal high water table; low to moderate shrink-swell potential.	Somewhat poor drainage; seasonal high water table; low to moderate shrink-swell potential; medium compressibility; fair shear strength.	Loamy texture; seasonal high water table; wet conditions hinder operations; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately slow permeability.	High	Low.
No unfavorable features.	Good drainage; slight compressibility; good shear strength.	Sandy texture; low moisture content; good stability on thawing.	Slight: moderately rapid permeability; possible contamination of shallow water supplies.	Low	Low.
Seasonal high water table; low to moderate shrink-swell potential.	Somewhat poor drainage; seasonal high water table; slight compressibility; good shear strength.	Loamy texture; seasonal high water table; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderate permeability in subsoil; very rapid permeability in underlying material.	Moderate	Low.
Cuts and fills needed in a few areas; low to moderate shrink-swell potential.	Good drainage; moderate shrink-swell potential; medium compressibility; fair shear strength.	Sandy texture; poor stability on thawing.	Severe: moderately slow permeability in loamy subsoil and underlying material.	Moderate	Low.
Seasonal high water table; low to moderate shrink-swell potential.	Somewhat poor drainage; seasonal high water table; low to moderate shrink-swell potential; medium compressibility; poor to fair shear strength.	Sandy and loamy texture; seasonal high water table; wet conditions hinder operations; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately rapid permeability in upper subsoil; moderately slow permeability in lower part of subsoil and underlying material.	High	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Miami: MuB, MuB2, MuC, MuC2, MuD2, MuE2, MvD3.	MuB and MuC units, fair: loamy; moderate organic-matter content; friable. All other units, poor: moderately and severely eroded, hilly to steep.	Not suitable	Not suitable	Fair: poor to fair stability; fair workability; low to moderate shrink-swell potential.
Mine pits: Mw. Properties variable; onsite investigation needed.				
Newaygo: NyB	Fair: loamy; moderate organic-matter content; friable.	Fair: some fines and gravel.	Fair to good: sandy; some fines.	Good: good stability and workability.
Ottokee: OkA	Poor: sandy; low organic-matter content; very friable.	Good: some fines.	Not suitable	Fair: fair stability and workability.
*Owosso: OmB, OmC, OmD2. For Miami part, see Miami series.	Fair in OmB and OmC: loamy; moderate organic-matter content; friable. OmD2 unit, poor: moderately eroded; hilly.	Not suitable	Not suitable	Fair: poor to fair stability; fair workability; low to moderate shrink-swell potential.
Plainfield, slightly acid variant: PfB, PfC.	Poor: sandy; low organic-matter content; very friable.	Good	Not suitable	Fair: fair stability and workability.
Richter: RhA	Poor: sandy; low organic-matter content; friable.	Not suitable	Not suitable	Fair: fair stability and workability; somewhat poor drainage.
Sebewa: Sd	Good: loamy; high organic-matter content; friable; poor drainage.	Fair for underlying material; some gravel.	Fair to good for underlying material; sandy.	Fair: fair stability; fair to good workability; poor drainage.

roadbuilding and community development—Continued

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
Cuts and fills needed in many areas; low to moderate shrink-swell potential.	Good drainage; low to moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; fair stability on thawing.	Slight on 2 to 12 percent slopes: moderate permeability; seep areas and wet depressions. Moderate on 12 to 18 percent slopes. Severe on 18 to 25 percent slopes: installation and operation of disposal fields are difficult on slopes of more than 12 percent.	Moderate	Low.
No unfavorable features.	Good drainage; slight compressibility; good shear strength.	Loamy texture; low moisture content; good stability on thawing.	Slight: moderate permeability in subsoil; rapid permeability in underlying material; possible contamination of shallow water supplies.	Low	Low.
Loose sand hinders operations.	Moderately good drainage; slight compressibility; good shear strength.	Sandy texture; low moisture content; good stability on thawing.	Slight: rapid permeability; possible contamination of shallow water supplies.	Low	Low.
Cuts and fills needed in many areas; low to moderate shrink-swell potential.	Good drainage; low to moderate shrink-swell potential; medium to high compressibility; poor to fair shear strength.	Loamy texture; fair stability on thawing.	Moderate to severe: moderately rapid permeability in upper part of subsoil; moderately slow permeability in lower part of subsoil and in underlying material; installation and operation of disposal fields are difficult on slopes of more than 12 percent.	Moderate	Low.
Loose sand hinders operations.	Good drainage; slight compressibility; good shear strength.	Sandy texture; low moisture content; good stability on thawing.	Slight: rapid permeability; possible contamination of shallow water supplies.	Low	Moderate.
Seasonal high water table.	Somewhat poor drainage; seasonal high water table; slight compressibility; fair shear strength.	Sandy texture; seasonal high water table; wet conditions hinder operations; poor to fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately rapid permeability.	Moderate	Low.
High water table	Poor drainage; high water table; slight compressibility; good shear strength.	Loamy texture; high water table; wet conditions hinder operations; poor to fair stability on thawing.	Severe: poor drainage; high water table; moderate permeability in subsoil; very rapid permeability in the underlying material.	High	Low.

TABLE 7.—*Engineering interpretations for*

Soil series and map symbols	Suitability as source of—			
	Topsoil	Sand	Gravel	Road fill
Shoals: Sh	Good: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Poor: poor stability; fair workability; high susceptibility to frost action; somewhat poor drainage.
Sloan: Sn	Good: loamy; high organic-matter content; friable; poor drainage.	Not suitable	Not suitable	Poor: poor stability; fair workability; high susceptibility to frost action; poor drainage.
Spinks: SpA, SpB, SpC, SpD	Poor: sandy; low organic-matter content; very friable; hilly in some areas.	Good: some fines.	Not suitable	Fair: fair stability and workability.
Tawas: Ta	Poor: organic material. Fair to good if mixed with mineral material; friable; very poor drainage.	Fair: sandy material at a depth ranging from 12 to 42 inches; organic material hinders excavation.	Not suitable	Not suitable for upper organic layers: poor stability; high compressibility. Fair for underlying sandy material: fair stability and workability; very poor drainage.
Tuscola: TsB	Fair: loamy; moderate organic-matter content; friable.	Not suitable	Not suitable	Poor: poor stability: fair workability; high susceptibility to frost action; erodible.
Wallkill: Wa	Good: loamy; high organic-matter content; friable; very poor drainage.	Not suitable	Not suitable	Poor in upper 10 to 40 inches: poor stability; fair workability; low to moderate shrink-swell potential; very poor drainage. Not suitable below a depth of 10 to 40 inches: organic material.
Wasepi: WeA, WeB	Fair: loamy; moderate organic-matter content; friable; cobblestones in some areas.	Fair: some fines and gravel.	Fair: sandy; some fines.	Fair: fair stability and workability; somewhat poor drainage; cobblestones in some areas.

roadbuilding and community development—Continued

Soil features affecting—			Limitations for use as sewage-disposal field	Corrosion potential	
Highway location	Foundations for low buildings	Winter grading		Uncoated steel conduits	Concrete conduits
Seasonal high water table; flood hazard; poor stability; high susceptibility to frost action.	Somewhat poor drainage; seasonal high water table; medium compressibility; poor shear strength; high susceptibility to frost action.	Loamy texture; seasonal high water table; wet conditions hinder operations; poor stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; flood hazard; moderate permeability.	High	Low.
High water table; flood hazard; poor stability; high susceptibility to frost action.	Poor drainage; high water table; medium compressibility; poor shear strength; high susceptibility to frost action.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: poor drainage; high water table; flood hazard; moderate permeability.	High	Low.
Loose sand hinders operations.	Good drainage; slight compressibility; fair to good shear strength.	Sandy texture; low moisture content; good stability on thawing.	Slight on 0 to 12 percent slopes: moderately rapid permeability; possible contamination of shallow water supplies. Moderate on 12 to 18 percent slopes: installation and operation of disposal fields are difficult on slopes of more than 12 percent.	Low	Low.
High water table; poor stability; organic material must be removed.	Very poor drainage; high water table; slight compressibility; fair to good shear strength.	Organic material; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: very poor drainage; high water table; moderately rapid permeability; unstable organic material.	High	Low.
Poor stability; high susceptibility to frost action; erodible.	Moderately good drainage; medium compressibility; poor shear strength; high susceptibility to frost action.	Loamy texture; poor stability on thawing.	Slight to moderate: moderate permeability; fine soil material; clogs tile in places.	Moderate	Low.
High water table; poor stability; underlying organic material must be removed.	Very poor drainage; high water table; high compressibility; poor shear strength; poor stability.	Loamy texture; high water table; wet conditions hinder operations; poor stability on thawing.	Severe: very poor drainage; high water table; moderate permeability in subsoil; moderately rapid permeability in underlying organic material; organic material is unstable.	High	Low.
Seasonal high water table; cobblestones in some areas.	Somewhat poor drainage; seasonal high water table; slight compressibility; fair to good shear strength.	Loamy texture; seasonal high water table; fair stability on thawing.	Severe: somewhat poor drainage; seasonal high water table; moderately rapid permeability.	Moderate	Low.

TABLE 8.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soils in for referring to other series that

Soil series and map symbols	Soil features affecting—	
	Agricultural drainage	Irrigation
Abscota Mapped only with Eel and Landes soils.	Good drainage; rapid permeability; flood hazard.	Low available water capacity; moderately rapid water intake rate.
Algansee: Ah	Somewhat poor drainage; seasonal high water table; rapid permeability; flood hazard.	Low available water capacity; seasonal high water table; moderately rapid water intake rate; somewhat poor drainage.
Barry: Ba, Bc	Poor drainage; high water table; moderate permeability; wet depressions in some areas; stones in Bc unit.	Moderate available water capacity; moderate water intake rate; poor drainage; stones in Bc unit.
Barry, bedrock variant: Bb	Poor drainage; high water table; sandstone bedrock at depth of 24 to 40 inches; moderately rapid permeability above bedrock; wet depressions in some areas.	Low available water capacity; moderately rapid water intake rate; poor drainage; sandstone bedrock at depth of 24 to 40 inches.
Belding: BeA	Somewhat poor drainage; seasonal high water table; moderately rapid permeability in upper part of subsoil, moderately slow permeability in lower part of subsoil and in underlying material.	Moderate available water capacity; moderately rapid water intake rate; somewhat poor drainage.
Berville: Bh	Poor drainage; high water table; moderately slow permeability; wet depressions in some areas.	High available water capacity; moderate to slow water intake rate; poor drainage.
Boyer: BmA, BmB, BmC, BmD, BmE, BoB, BrA, BrB, BrC, BrD.	Good drainage; moderately rapid permeability.	Low available water capacity; moderately rapid water intake rate; sloping soils subject to runoff and erosion; cobblestones in some areas; stones in BoB unit.
Breckenridge: Bt	Poor drainage; high water table; moderately rapid permeability in subsoil, moderately slow permeability in underlying material.	Moderate available water capacity; moderately rapid water intake rate; poor drainage.
Brevort: Bv	Poor drainage; high water table; rapid permeability in subsoil, moderately slow permeability in underlying material; wet depressions in some areas; ditchbanks unstable.	Low to moderate available water capacity; rapid water intake rate; poor drainage.
Brookston: Bw	Poor drainage; high water table; moderately slow permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; poor drainage.
Carlisle: Cg	Very poor drainage; high water table; moderately rapid permeability; organic material is subject to subsidence if overdrained; controlled water table desirable.	Very high available water capacity; rapid water intake rate; poor drainage; hazard of soil blowing.

interpretations for farm uses

such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions appear in the first column of this table]

Soil features affecting—Continued			
Terraces and diversions	Grassed waterways	Farm ponds	
		Reservoir area	Embankment
Not needed: nearly level	Not needed: nearly level	Rapid seepage rate; too sandy and porous to hold water unless seal blanket is used; flood hazard.	Fair stability and compaction characteristics; rapid seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; rapid seepage rate; too sandy and porous to hold water unless seal blanket is used; flood hazard.	Fair stability and compaction characteristics; rapid seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; moderate seepage rate; stones in Bc unit.	Fair to good stability and compaction characteristics; moderate seepage rate; piping hazard; stones in Bc unit.
Not needed: nearly level	Not needed: nearly level	High water table; moderate to rapid seepage rate; sandstone bedrock at depth of 24 to 40 inches; cobblestones.	Sandstone bedrock at depth of 24 to 40 inches; material above the sandstone bedrock, good stability and fair compaction characteristics; cobblestones; rock fragments.
Not needed: nearly level	Seasonal high water table	Seasonal high water table; moderate to rapid seepage rate.	Fair to good stability and compaction characteristics; piping hazard; slow seepage rate.
Not needed: nearly level	Not needed: nearly level	High water table; slow to moderate seepage rate.	Fair to good stability and compaction characteristics; slow seepage rate.
Slopes of 0 to 25 percent; slopes too steep and irregular in many areas; runoff and erosion hazards; cobblestones in some areas; stones in BoB unit; cuts expose gravelly sand in places.	Low available water capacity; low natural fertility; difficult to vegetate if deep cuts expose gravelly sand; medium to rapid runoff in many areas.	Moderate seepage rate in subsoil; rapid seepage rate in the underlying material; seal blanket required if underlying material is exposed.	Good stability; fair to good compaction characteristics in subsoil, variable stability and compaction characteristics in underlying material; moderate to rapid seepage rate; cobblestones in some areas; stones in BoB unit.
Not needed: nearly level	Not needed: nearly level	High water table; moderate seepage rate; suited for pit-type ponds.	Fair to good stability and compaction characteristics; medium to slow seepage rate.
Not needed: nearly level	Not needed. nearly level	High water table; rapid seepage rate in upper part of sandy material, slow seepage rate in lower part of loamy material; suited for pit-type ponds.	Fair stability and compaction characteristics; moderate to slow seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; moderate to slow seepage rate.	Fair to good stability and compaction characteristics; slow seepage rate.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; unstable organic material; flotation hazard.	Unstable organic material; not suitable.

TABLE 8.—*Engineering*

Soil series and map symbols	Soil features affecting—	
	Agricultural drainage	Irrigation
Celina: ChB, ChB2	Moderately good drainage; moderately slow permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; runoff and erosion hazard on sloping soils.
Ceresco: Cm	Somewhat poor drainage; seasonal high water table; moderately rapid permeability; subject to flooding.	Moderate available water capacity; moderately rapid water intake rate; somewhat poor drainage.
Cohoctah: Cn	Poor drainage; high water table; moderately rapid permeability; flood hazard.	Moderate available water capacity; moderately rapid water intake rate; poor drainage.
Colwood: Cs	Poor drainage; high water table; moderate permeability; fine soil material clogs tile in places; ditchbanks unstable.	High available water capacity; moderate water intake rate; poor drainage.
Conover: CtA, CtB	Somewhat poor drainage; seasonal high water table; moderately slow permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; somewhat poor drainage.
Edwards: Ek	Very poor drainage; high water table; moderately rapid permeability in organic material, variable permeability in the underlying marl; controlled drainage desirable.	Very high available water capacity; rapid water intake rate; very poor drainage; hazard of soil blowing.
*Eel: En For Landes and Abscota parts, see Landes and Abscota series.	Moderately good drainage; moderate permeability; flood hazard.	High available water capacity; moderate water intake rate.
Fox: FoB, FoC, FoD	Good drainage; moderate permeability.	Moderate available water capacity; moderately rapid water intake rate; runoff and erosion hazard on moderately sloping soils.
Gilford: Gg, Gh	Poor drainage; high water table; moderately rapid permeability; ditchbanks unstable; cobblestones and stones in a few areas.	Low available water capacity; moderately rapid water intake rate; poor drainage; cobblestones and stones in a few areas.
Gladwin: GmA	Somewhat poor drainage; seasonal high water table; moderate permeability; ditchbanks unstable.	Low available water capacity; rapid water intake rate; somewhat poor drainage; hazard of soil blowing.
Glendora: Gn	Poor drainage; high water table; rapid permeability; flood hazard.	Low available water capacity; rapid water intake rate; poor drainage.
Granby: Go	Poor drainage; high water table; rapid permeability; ditchbanks unstable.	Low available water capacity; rapid water intake rate; poor drainage; hazard of soil blowing.

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Soil features affecting—Continued			
Terraces and diversions	Grassed waterways	Farm ponds	
		Reservoir area	Embankment
Slopes of 2 to 6 percent	No unfavorable features	Moderate to slow seepage rate	Fair stability and compaction characteristics; slow seepage rate.
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; moderately rapid seepage rate; flood hazard.	Good stability; fair to good compaction characteristics; moderate seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; moderately rapid seepage rate; flood hazard.	Good stability; fair to good compaction characteristics; moderate seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; moderate seepage rate; sides of pond unstable when wet.	Poor to fair stability and compaction characteristics; moderate seepage rate; piping hazard.
Slopes of 0 to 6 percent	No unfavorable features	Seasonal high water table; moderate to slow seepage rate.	Fair stability and compaction characteristics; slow seepage rate.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; organic material and marl unstable; flotation hazard.	Unstable organic material and marl; not suitable.
Not needed: nearly level	Not needed: nearly level	Moderate to slow seepage rate; flood hazard.	Poor stability and compaction characteristics; moderate to slow seepage rate; piping hazard.
Slopes of 2 to 18 percent; slopes are too steep and irregular in many areas; runoff and erosion hazard; cobblestones in some areas; cuts expose gravelly sand in places.	Runoff and erosion hazards; cobblestones in some areas.	Moderate seepage rate in subsoil, rapid seepage rate in underlying material; seal blanket required if underlying material is exposed.	Good stability; fair to good compaction characteristics in subsoil, variable stability and compaction characteristics in underlying material; moderate to rapid seepage rate; cobblestones in some areas.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; suited for pit-type ponds.	Good stability; fair to good compaction characteristics in subsoil, fair to poor stability and compaction characteristics in underlying material; moderate to rapid seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; rapid seepage rate.	Good stability; fair to good compaction characteristics in subsoil, fair to poor stability and compaction characteristics in underlying material; moderate to rapid seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; flooding.	Fair stability and compaction characteristics; rapid seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; sides of pond unstable.	Poor stability; fair to poor compaction characteristics; rapid seepage rate; piping hazard.

TABLE 8.—*Engineering*

Soil series and map symbols	Soil features affecting—	
	Agricultural drainage	Irrigation
Gravel pits: Gp Properties variable; onsite investigation needed.		
Iosco: IsA, ItA	Somewhat poor drainage; seasonal high water table; rapid permeability in the upper part of subsoil, moderately slow permeability in lower part of subsoil and in underlying material; cobblestones and stones in some areas; ditchbanks unstable.	Low to moderate available water capacity; rapid water intake rate; somewhat poor drainage; cobblestones and stones in some areas; hazard of soil blowing.
Iosco, deep variant: Iv	Somewhat poor drainage; seasonal high water table; rapid to moderately slow permeability; ditchbanks unstable.	Low to moderate available water capacity; rapid water intake rate; somewhat poor drainage; hazard of soil blowing.
Kendallville: KhB, KhB2, KhC, KhC2	Good drainage; moderate to moderately slow permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; runoff and erosion hazard on sloping soils.
Kibbie: KnA, KnB	Somewhat poor drainage; seasonal high water table; moderate permeability; fine soil material clogs tile in places; ditchbanks unstable.	High available water capacity; moderate water intake rate; somewhat poor drainage.
Landes Mapped only with Eel and Abscota soils.	Good drainage; moderately rapid permeability.	Moderate available water capacity; moderately rapid water intake rate.
Lapeer: LmB, LmC2	Good drainage; moderate permeability.	Moderate available water capacity; moderate water intake rate; runoff and erosion hazard on sloping soils.
Lenawee: Ln	Poor drainage; high water table; moderately slow permeability; wet depressions in some areas.	High available water capacity; slow water intake rate; poor drainage.
Linwood: Lo	Very poor drainage; high water table; moderately rapid permeability in organic material, moderate permeability in underlying material; organic material subsides if overdrained; controlled drainage desirable.	Very high available water capacity; rapid water intake rate; very poor drainage.
Locke: LsA, LsB	Somewhat poor drainage; seasonal high water; moderate permeability.	Moderate available water capacity; moderate water intake rate; somewhat poor drainage.
Macomb: MaA, MbB	Somewhat poor drainage; seasonal high water table; moderately slow permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; somewhat poor drainage.
Made land: Md. Properties variable; onsite investigation needed.		
Mancelona: MeA, MeB	Good drainage; moderately rapid permeability.	Low available water capacity; rapid water intake rate; hazard of soil blowing.

interpretations for farm uses—Continued

Soil features affecting—Continued			
Terraces and diversions	Grassed waterways	Farm ponds	
		Reservoir area	Embankment
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; moderately rapid seepage rate.	Fair stability and compaction characteristics in upper part of subsoil, fair to good stability and compaction characteristics in lower part of subsoil and underlying material; moderate to slow seepage rate; stones in ItA unit.
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; moderately rapid seepage rate.	Fair to good stability and compaction characteristics; slow seepage rate; piping hazard.
Slopes of 2 to 12 percent; runoff and erosion hazard.	Runoff and erosion hazard	Moderate seepage rate	Fair to good stability and compaction characteristics; moderate to slow seepage rate.
Seasonal high water table	Seasonal high water table	Seasonal high water table; moderate seepage rate; sides of pond unstable when wet.	Poor to fair stability and compaction characteristics; moderate seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	Moderately rapid seepage rate; flood hazard.	Good stability and compaction characteristics; moderate seepage rate; piping hazard.
Slopes of 2 to 12 percent; runoff and erosion hazard.	Runoff and erosion hazard	Moderate seepage rate	Good stability and compaction characteristics; moderate seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; slow seepage rate.	Fair to good stability and compaction characteristics: slow seepage rate.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; organic material unstable; flotation hazard.	Unstable organic material; not suitable; fair to good stability and compaction characteristics in underlying material; slow seepage rate.
Seasonal high water table	Seasonal high water table	Seasonal high water table; moderate seepage rate.	Good stability; fair to good compaction characteristics; moderate seepage rate; piping hazard.
Seasonal high water table	Seasonal high water table	Seasonal high water table; moderate seepage rate.	Fair to good stability and compaction characteristics; slow seepage rate.
Slopes of 0 to 6 percent; cuts expose gravelly sand in places.	Low natural fertility and available water capacity; difficult to vegetate.	Rapid seepage rate; too sandy and porous to hold water unless seal blanket is used.	Good stability; fair to good compaction characteristics in subsoil, variable stability and compaction characteristics in underlying material; moderate to rapid seepage rate; piping hazard.

TABLE 8.—*Engineering*

Soil series and map symbols	Soil features affecting—	
	Agricultural drainage	Irrigation
Matherton: MmA, MmB, MnA, MnB	Somewhat poor drainage; seasonal high water table; moderate permeability in subsoil, very rapid permeability in the underlying material; ditchbanks unstable.	Moderate available water capacity; moderate water intake rate; somewhat poor drainage.
Menominee: MoB, MoC	Good drainage; rapid permeability in upper part of subsoil, moderately slow permeability in the lower part of subsoil and in underlying material.	Low to moderate available water capacity; rapid water intake rate; runoff and erosion hazard on sloping soils.
Metamora: MrA, MsA, MsB	Somewhat poor drainage; seasonal high water table; moderately rapid permeability in upper part of subsoil, moderately slow permeability in lower part of subsoil and in underlying material.	High available water capacity; moderately rapid water intake rate; somewhat poor drainage.
Miami: MuB, MuB2, MuC, MuC2, MuD2, MuE2, MvD3.	Good drainage; moderate permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; runoff and erosion hazard on sloping soils.
Mine pits: Mw. Properties variable; onsite investigation needed.		
Newaygo: NyB	Good drainage; moderate permeability in subsoil, rapid permeability in underlying material.	Moderate available water capacity; moderate water intake rate.
Ottokee: OkA	Moderately good drainage; rapid permeability.	Low available water capacity; rapid water intake rate; hazard of soil blowing.
*Owosso: OmB, OmC, OmD2. For Miami part, see Miami series.	Good drainage; moderately rapid permeability in upper part of subsoil, moderately slow permeability in lower part of subsoil and in underlying material.	Moderate available water capacity; moderate water intake rate; runoff and erosion hazard on sloping soils.
Plainfield, slightly acid variant: PfB, PfC	Good drainage; rapid permeability	Low available water capacity; rapid water intake rate; hazard of soil blowing.
Richter: RhA	Somewhat poor drainage; seasonal high water table; moderately rapid permeability.	Moderate available water capacity; moderately rapid water intake rate; somewhat poor drainage.
Sebewa: Sd	Poor drainage; moderate permeability in subsoil, very rapid permeability in underlying material; ditchbanks unstable.	Moderate available water capacity; moderate water intake rate; poor drainage.

interpretations for farm uses—Continued

Soil features affecting—Continued			
Terraces and diversions	Grassed waterways	Farm ponds	
		Reservoir area	Embankment
Seasonal high water table	Seasonal high water table	Seasonal high water table; moderate seepage rate in subsoil, very rapid seepage rate in underlying material; seal blanket required if underlying material is exposed.	Fair to good stability and compaction characteristics in subsoil, variable stability and compaction characteristics in underlying material; moderate to rapid seepage rate; piping hazard.
Slopes of 2 to 12 percent; sandy soil; difficult to vegetate.	Low to moderate available water capacity; low natural fertility; medium runoff in some areas; difficult to vegetate.	Rapid seepage rate in upper part of sandy material, slow seepage rate in lower part of loamy material; sides of ponds unstable when wet.	Fair to good stability and compaction characteristics; slow seepage rate; piping hazard.
Seasonal high water table	Seasonal high water table	Seasonal high water table; moderate seepage rate.	Fair to good stability and compaction characteristics; slow seepage rate.
Slopes of 2 to 25 percent; slopes too steep and irregular in many areas; runoff and erosion hazard.	Runoff and erosion hazard	Moderate to slow seepage rate	Fair stability and compaction characteristics; slow seepage rate.
Slopes of 2 to 6 percent; cuts expose gravelly sand in places.	No unfavorable features	Moderate seepage rate in subsoil, rapid seepage rate in underlying material; seal blanket required if underlying material is exposed.	Fair to good stability and compaction characteristics in the subsoil, variable stability and compaction characteristics in underlying material; moderate to rapid seepage rate.
Not needed: nearly level	Not needed: nearly level	Rapid seepage rate; too sandy and porous to hold water unless seal blanket is used.	Fair to poor stability and compaction characteristics; rapid seepage rate; piping hazard.
Slopes of 2 to 18 percent; slopes too steep and irregular in a few areas; runoff and erosion hazard.	Runoff and erosion hazard	Moderate to slow seepage rate	Fair to good stability and compaction characteristics; moderate to slow seepage rate.
Slopes of 2 to 12 percent; sandy soil, difficult to vegetate.	Low natural fertility and available water capacity; difficult to vegetate.	Rapid seepage rate; too sandy and porous to hold water unless seal blanket is used.	Poor stability; poor to fair compaction characteristics; rapid seepage rate.
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; moderately rapid seepage rate.	Good stability; fair to good compaction characteristics; moderate seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; moderate seepage rate in subsoil, very rapid seepage rate in underlying material; suited for pit-type ponds.	Fair to good stability and compaction characteristics in subsoil, variable stability and compaction characteristics in underlying material; moderate to rapid seepage rate.

TABLE 8.—*Engineering*

Soil series and map symbols	Soil features affecting—	
	Agricultural drainage	Irrigation
Shoals: Sh	Somewhat poor drainage; seasonal high water table; moderate permeability; flooding hazard.	High available water capacity; moderate water intake rate; somewhat poor drainage.
Sloan: Sn	Poor drainage; high water table; moderate permeability; flooding hazard.	High available water capacity; moderate water intake rate; poor drainage.
Spinks: SpA, SpB, SpC, SpD	Good drainage; moderately rapid permeability.	Low available water capacity; rapid water intake rate; soil blowing.
Tawas: Ta	Very poor drainage; high water table; moderately rapid permeability in organic material, rapid permeability in underlying material; organic material subsides when overdrained; controlled drainage desirable; ditchbanks unstable.	Very high available water capacity; rapid water intake rate; very poor drainage; hazard of soil blowing.
Tuscola: TsB	Moderately good drainage; moderate permeability; wet depressions in some areas.	High available water capacity; moderate water intake rate; runoff and erosion hazard.
Wallkill: Wa	Very poor drainage; high water table; moderate permeability in subsoil, moderately rapid permeability in underlying material; organic material has poor stability and subsides; wet depressions in some areas.	High to very high available water capacity; moderate water intake rate; very poor drainage.
Wasepi: WeA, WeB	Somewhat poor drainage; seasonal high water table; moderately rapid permeability; cobblestones in some areas; ditchbanks unstable.	Low available water capacity; moderately rapid water intake rate; somewhat poor drainage.

interpretations for farm uses—Continued

Soil features affecting—Continued			
Terraces and diversions	Grassed waterways	Farm ponds	
		Reservoir area	Embankment
Not needed: nearly level	Not needed: nearly level	Seasonal high water table; moderate to slow seepage rate; flooding hazard.	Poor stability and compaction characteristics; moderate seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; moderate to slow seepage rate; flooding hazard.	Poor stability and compaction characteristics; moderate seepage rate; piping hazard.
Slopes of 0 to 18 percent; sandy soil, difficult to vegetate.	Low available water capacity and natural fertility; difficult to vegetate.	Rapid seepage rate; too sandy and porous to hold water unless seal blanket is used.	Fair to poor stability and compaction characteristics; rapid seepage rate; piping hazard.
Not needed: nearly level	Not needed: nearly level	High water table; rapid seepage rate; organic material unstable; flotation hazard.	Unstable organic material, not suitable; fair to poor stability and compaction characteristics in underlying material; rapid seepage rate; piping hazard.
Hazard of erosion	Erosion hazard	Moderate seepage rate; sides of ponds are unstable when wet.	Poor stability and compaction characteristics; moderate seepage rate; piping hazard.
Not needed; nearly level	No unfavorable features	High water table; slow seepage rate in subsoil, rapid seepage rate in underlying material.	Fair to poor stability and compaction characteristics; moderate seepage rate in subsoil; underlying organic material not suitable.
Seasonal high water table	Low available water capacity; seasonal high water table.	Seasonal high water table; moderately rapid seepage rate in subsoil, rapid seepage rate in underlying material; seal blanket required if underlying material is exposed.	Good stability and fair to good compaction characteristics in subsoil, poor stability and fair to poor compaction characteristics in underlying material; moderate to rapid seepage rate; piping hazard.

Formation and Classification of the Soils[6]

This section explains how the factors of soil formation have affected development of the soils in Shiawassee County. It also explains the system of soil classification and places each soil series in the various classes of the system.

Terms common in the current classification system that are used in this section are defined in the Glossary at the back of this survey or in "Soil Classification, a Comprehensive System" and its supplements (*5*).

Factors of Soil Formation

Soil forms through the interaction of five major factors: the physical and mineralogical composition of the parent material; the plant and animal life on and in the soil; the climate under which the soil material has accumulated and existed since accumulation; the relief, or lay of the land; and the length of time the forces of soil formation have acted on the parent material.

Climate and plant and animal life are the active factors in soil formation. They slowly change the parent material into a natural body of soil that has genetically related layers, called horizons. The effects of climate and plant and animal life are conditioned by relief. The nature of the parent material also affects the kind of soil profile that is formed and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil profile. It may be much or little, but some time is required for differentiation of soil horizons. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes of soil development are unknown.

Parent material

Parent material is the unconsolidated mass in which a soil is formed. The parent material of the soils of Shiawassee County was deposited by glaciers or by melt water from the glaciers that covered the county about 10,000 to 12,000 years ago. Some of this material has been reworked and redeposited by subsequent water and wind action. Parent material determines the limits of the chemical and mineralogical composition of the soil. Although the parent material is of common glacial origin, its properties vary greatly, even within small areas, depending on how the material was deposited. The dominant parent material in Shiawassee County was deposited as glacial till, outwash deposits, lacustrine deposits, alluvium, and organic material.

Glacial till is material laid down directly by glaciers by a minimum of water action. It consists of particles of different sizes that are mixed together. The small pebbles in glacial till have sharp corners, indicating that they have not been worn by water washing. The glacial till in Shiawassee County is calcareous and friable or firm. Its texture is sandy loam, loam, or clay loam. An example of soils formed in glacial till are those of the Conover series. These soils are loamy in texture and have well-developed structure.

Outwash material is deposited by running water from melting glaciers. The size of the particles that make up outwash material varies according to the speed of the stream of water that carried them. When the water slows down, the coarser particles are deposited. Finer particles, such as very fine sand, silt, and clay, can be carried by slowly moving water. Outwash deposits generally consist of layers of particles of similar size. Sandy loam, sand, gravel, and other coarse particles are the dominant textures. The Mancelona soils, for example, formed in deposits of outwash material in Shiawassee County.

Lacustrine material is deposited from still, or ponded, glacial melt water. Because the coarser fragments drop out of moving water as outwash, only the finer particles, such as very fine sand, silt, and clay, remain to settle out in still water. Lacustrine deposits are loamy in texture. In Shiawassee County soils that formed in lacustrine deposits typically have a loamy texture. The Lenawee series is an example of soils formed in lacustrine material.

Alluvium material is deposited by floodwaters of present streams in recent time. This material ranges in texture, depending on the speed of the water from which it was deposited. The alluvium deposited along a swift stream, such as the Maple River, is therefore coarser in texture than that deposited along a slow, sluggish stream, such as the Shiawassee River. Examples of alluvial soils are those of the Abscota and Sloan series.

Organic material is made up of deposits of plant remains. After the glaciers retreated, water was left standing in depressions in outwash plains, lake plains, and till plains. Grasses and sedges growing around the edges of these lakes died out, and the dead plants fell to the bottom. Because of wetness of the areas, the plants did not decompose but remained around the edge of the lake. Later, white-cedar and other water-tolerant trees grew in the areas. As these trees died, the residue became a part of the organic accumulation. The lakes were eventually filled with organic material and developed into areas of muck and peat. In some of these areas, the plant remains subsequently decomposed. In other areas, the material has changed little since deposition. Soils of the Carlisle series are an example of soils formed in organic material.

Plant and animal life

Plants have been the principal organism influencing the soils in Shiawassee County; however, bacteria, fungi, earthworms and the activities of man have also been important. The chief contribution of plant and animal life is the addition of organic matter and nitrogen to the soil. The kind of organic material on and in the soil depends on the kind of plants that grew on the soil. The remains of these plants accumulate on the surface, decay, and eventually become organic matter. Roots of the plants provide channels for downward movement of water through the soil and also add organic matter as they decay. Bacteria in the soil help to break down the organic matter so that it can be used by growing plants.

[6] R. W. JOHNSON, State soil scientist, and H. R. SINCLAIR, JR., assistant State soil scientist, Soil Conservation Service, helped prepare this section.

The vegetation in Shiawassee County was mainly deciduous forest. Differences in natural soil drainage, and minor difference in parent material affected the composition of the forest species.

In general, the well-drained soils of the uplands, such as the Lapeer, Owosso, and Miami soils, were mainly covered with hardwoods and pines. A few wet soils also had sphagnum and other mosses that contributed substantially to the accumulation of organic matter. The Carlisle and Linwood soils developed under wet conditions and contain considerable amounts of organic matter. The soils that formed under dominantly forest vegetation generally have less total accumulated organic matter than soils in other parts of the county that formed under dominantly grass vegetation.

Climate

Climate is important in the formation of soils. It determines the kind of plant and animal life on and in the soil. It determines the amount of water available for weathering of minerals and the transporting of soil materials. Climate, through its influence on temperatures in the soil, determines the rate of chemical reaction that occurs in the soil. These influences are important, but they affect large areas rather than a relatively small area, such as a county.

The climate of Shiawassee County is cool and humid. Presumably, it is similar to that in existence when the soils formed. The soils of this county differ from soils formed in a dry, warm climate or from those that formed in a hot, moist climate. Climate is uniform throughout the county, although its effect is modified locally by topography. The differences in the soils of Shiawassee County result to only a minor extent from differences in climate.

Relief

Relief, or topography, has a marked influence on the soils of Shiawassee County, through its influence on natural drainage, erosion, plant cover, and soil temperature. The slope ranges from nearly level to steep. Natural soil drainage ranges from good on the ridgetops to very poor in the depressions.

Relief influences the formation of soils by affecting runoff and drainage; drainage in turn, through its effect on aeration of the soil, determines the color of the soil. Runoff of water is greatest on the steeper soils, but in low areas, water is temporarily ponded. Water and air move freely through soils that are well drained but slowly through soils that are very poorly drained. In soils that are well aerated, the iron and aluminum compounds that give most soils their color are brightly colored and oxidized. In poorly aerated soils the color is a dull gray, and the soil is mottled. The Lapeer soils are examples of well-drained, well-aerated soils, and the Brookston soils are examples of poorly aerated, poorly drained soils.

Time

Time, generally a long time, is required by the agents of soil formation to form distinct horizons in the soil from parent material. Differences in length of time that parent material has been in place are commonly reflected in the degree of development of the soil profile. Some soils develop rapidly, others slowly.

The soils of Shiawassee County range from young to mature. The glacial deposits in which many of the soils formed have been exposed to soil-forming factors for a long enough time to allow distinct horizons to develop within the profile. Some soils, however, formed in recent alluvial sediment that has not been in place long enough for distinct horizons to develop.

The Cohoctah soils are examples of young soils that formed in alluvial material. The Conover and Kibbie soils are examples of the effect of time on leaching of lime from the soil. The Kibbie soils were submerged under glacial lake water and protected from leaching; they are effervescent at a depth of 26 inches. By contrast, the Conover soils were above water and subject to leaching; they are leached of lime to a depth of 36 inches. The Miami soils are examples of mature soils that formed in glacial till.

Differentiation of Soil Horizons

Several processes were involved in the formation of horizons of the soils of Shiawassee County. These processes are accumulation of organic matter; leaching of lime (calcium carbonates) and other bases; reduction and transfer of iron; and formation and translocation of silicate clay minerals. In most soils of Shiawassee County more than one of these processes have been active in the development of soil horizons.

Organic matter accumulates at the surface to form an A1 horizon. The A1 horizon is mixed into a plow layer (Ap) when the soil is plowed. In the soils of Shiawassee County, the organic-matter content of the surface layer ranges from high to low. The Brookston soils are examples of soils that have a high organic-matter content in the surface layer, and the slightly acid variant of Plainfield soils are examples of soils that have a low organic-matter content.

Leaching of carbonates and other bases has occurred in most of the soils. Soil scientists generally agree that leaching of bases in soils commonly precedes translocation of silicate clay minerals. Many of the soils are moderately to strongly leached. For example, the Conover soils are leached of carbonates to a depth of 36 inches.

Reduction and transfer of iron, a process called gleying, is evident in the somewhat poorly drained, poorly drained, and very poorly drained soils. The gray color in the subsoil horizons indicates the reduction and loss of iron. Brookston soils are examples of gleyed soils. Some horizons contain mottles, indicating a segregation of iron. This process has taken place in Locke and Gladwin soils.

In some soils the translocation of clay minerals has contributed to horizon development. The eluviated (leached) A2 horizons above the illuviated (accumulation) B horizons have platy structure, are lower in content of clay, and generally are lighter in color. The B horizons generally have an accumulation of clay (clay films) in pores and on surfaces of peds. Probably, carbonates and soluble salts are leached out of these soils to a considerable extent before translocation of silicate clay takes place. The Lapeer soils are examples of soils where translocated silicate clays have accumulated in the B horizon in the form of clay films.

In some soils of Shiawassee County, iron, aluminum, and humus have moved from the surface layer to the B horizon. The Gladwin, Iosco, and Mancelona soils are examples of soils that have translocated iron, aluminum, and humus.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes; the many thousands of classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

The comprehensive classification system (*5*), the system currently used, was adopted by the National Cooperative Soil Survey in 1965. This system is under continual study. Readers interested in development of the system should search the latest available literature.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 9 shows the classification of each soil series of Shiawassee County by family, subgroup, and order, according to the current system. Brief explanations of the six categories follow.

ORDER.—Ten soil orders are recognized. They are Entisols, Vertisols, Inceptisols, Aridisols, Mollisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Two exceptions to this are Entisols and Histosols, which occur in many different climates. Six of the orders are represented in Shiawassee County: Alfisols, Entisols, Histosols, Inceptisols, Mollisols, and Spodosols.

Alfisols are soils that have a clay-enriched B horizon that is high in base saturation. Celina, Lapeer, and Miami soils represent the Alfisols in Shiawassee County.

Entisols are recent soils; they lack genetic horizons or have only the beginnings of such horizons. The Brevort soils are examples of Entisols in Shiawassee County.

Inceptisols are generally on young but not recent land surfaces. Eel soils are examples of Inceptisols.

Mollisols are soils that have a thick, dark-colored surface layer. Brookston soils are an example of Mollisols in the county.

Spodosols are soils that have a B horizon enriched with iron, aluminum, and humus. In Shiawassee County Spodosols are represented by the Gladwin, Iosco, and Mancelona soils.

Histosols are soils formed in organic material. They include soils commonly called muck, peat, organic soils, and bog soils. Carlisle soils are an example of Histosols in Shiawassee County.

SUBORDER.—Each order is divided into suborders, mainly on the basis of soil characteristics that result in grouping soils according to genetic similarity. The climatic range is narrower than that of the order. The properties used are mainly those that reflect the presence or absence of waterlogging or differences in climate or vegetation.

GREAT GROUP.—Each suborder is divided into great groups on the basis of similarity in the kind and sequence of major horizons and in major soil properties. The horizons considered are those in which clay, iron, or humus have accumulated and those in which pans that interfere with the growth of roots and the movement of water have formed. The properties are soil temperature and major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium).

TABLE 9.—*Classification of soil series by higher categories*

[As of March 1971; subject to change as more precise information becomes available]

Series	Family	Subgroup	Order
Abscota	Mixed, mesic	Typic Udipsamments	Entisols.
Algansee [1]	Mixed, mesic	Aquic Udipsamments	Entisols.
Barry	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Barry, bedrock variant	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Belding [1]	Coarse-loamy, mixed, frigid	Alfic Haplaquods	Spodosols.
Berville	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Boyer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Breckenridge [1]	Coarse-loamy, mixed, nonacid, frigid	Mollic Haplaquepts	Inceptisols.
Brevort [1]	Sandy over loamy, mixed, nonacid, frigid	Mollic Haplaquents	Entisols.
Brookston	Fine-loamy, mixed, mesic	Typic Argiaquolls	Mollisols.
Carlisle [2]	Euic, mesic	Typic Medisaprists	Histosols.
Celina [1]	Fine, mixed, mesic	Aquic Hapludalfs	Alfisols.
Ceresco [1]	Coarse-loamy, mixed, mesic	Fluvaquentic Hapludolls	Mollisols.
Cohoctah [1]	Coarse-loamy, mixed, mesic	Fluventic Haplaquolls	Mollisols.
Colwood	Fine-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Conover	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Edwards [2]	Marly, euic, mesic	Limnic Medisaprists	Histosols.

See footnotes at end of table.

TABLE 9.—*Classification of soil series by higher categories*—Continued

Series	Family	Subgroup	Order
Eel [1]	Fine-loamy, mixed, mesic	Fluvaquentic Eutrochrepts	Inceptisols.
Fox [1]	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Hapludalfs	Alfisols.
Gilford	Coarse-loamy, mixed, mesic	Typic Haplaquolls	Mollisols.
Gladwin [1]	Sandy, mixed, frigid	Alfic Haplaquods	Spodosols.
Glendora	Mixed, mesic	Mollic Psammaquents	Entisols.
Granby [1]	Sandy, mixed, mesic	Typic Haplaquolls	Mollisols.
Iosco [1]	Sandy over loamy, mixed, frigid	Aqualfic Haplorthods	Spodosols.
Iosco, deep variant	Sandy over loamy, mixed, mesic	Aqualfic Haplorthods	Spodosols.
Kendallville	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Kibbie	Fine-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Landes [1]	Coarse-loamy, mixed, mesic	Fluventic Hapludolls	Mollisols.
Lapeer	Coarse-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Lenawee	Fine, illitic, nonacid, mesic	Mollic Haplaquepts	Inceptisols.
Linwood [2]	Loamy, mixed, euic, mesic	Terric Medisaprists	Histosols.
Locke [1]	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.
Macomb	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Mancelona [1]	Sandy, mixed, frigid	Alfic Haplorthods	Spodosols.
Matherton	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Udollic Ochraqualfs	Alfisols.
Menominee [1]	Sandy over loamy, mixed, frigid	Alfic Haplorthods	Spodosols.
Metamora [1]	Fine-loamy, mixed, mesic	Udollic Ochraqualfs	Alfisols.
Miami	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Newaygo [1]	Fine-loamy over sandy or sandy-skeletal, mixed, frigid.	Alfic Haplorthods	Spodosols.
Ottokee [1]	Mixed, mesic	Alfic Udipsamments	Entisols.
Owosso	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Plainfield, slightly acid variant.	Mixed, mesic	Typic Udipsamments	Entisols.
Richter [1]	Coarse-loamy, mixed, frigid	Alfic Haplaquods	Spodosols.
Sebewa	Fine-loamy over sandy or sandy-skeletal, mixed, mesic.	Typic Argiaquolls	Mollisols.
Shoals	Fine-loamy, mixed, nonacid, mesic	Aeric Fluvaquents	Entisols.
Sloan	Fine-loamy, mixed, mesic	Fluventic Haplaquolls	Mollisols.
Spinks	Sandy, mixed, mesic	Psammentic Hapludalfs	Alfisols.
Tawas [1, 2]	Sandy, mixed, euic	Terric Borosaprists	Histosols.
Tuscola [1]	Fine-loamy, mixed, mesic	Typic Hapludalfs	Alfisols.
Wallkill [1]	Fine-loamy, mixed, nonacid, mesic	Thapto-Histic Fluvaquents	Entisols.
Wasepi [1]	Coarse-loamy, mixed, mesic	Aquollic Hapludalfs	Alfisols.

[1] These soils are taxadjuncts. The reasons for excluding them from the series with which they are here identified are as follows:
Algansee.—The matrix colors in the subhorizons are more grayish.
Belding, Brevort, Gladwin, Iosco, Mancelona, Menominee, Newaygo, Richter, Tawas.—The annual temperature is a few degrees warmer.
Breckenridge.—The annual temperature is a few degrees warmer, the matrix colors of some subhorizons are brighter, and the dark-colored surface layer is thicker.
Celina.—The Bt horizon averages a lower content of clay.
Ceresco, Cohoctah, Granby.—The dark-colored surface layer is thinner.
Eel.—The effervescent material within 40 inches of the surface is lacking.
Fox.—There is generally more gravel in the lower part of the solum.
Landes.—The surface layer is lighter colored and thinner.
Locke.—The Btg horizon generally has a higher content of clay.
Metamora.—The solum is more grayish in the upper part.
Ottokee.—The cumulative thickness of the Bt bands is greater and mottles are nearer the surface.
Tuscola.—The solum, 24 to 30 inches in thickness, is thinner and the Bt horizon has more grayish color on surfaces of peds.
Wallkill.—The loamy material, less than 16 inches thick, is thinner.
Wasepi.—The matrix color is less brownish in part of the B horizon.

[2] The classification in this table reflects, for information purposes only, the current placement of the series into the present classification of Histosols. The profile described in this survey as representative of the series does not reflect this placement in the current classification system.

In table 9 this category is not shown separately; the last word in the name of the subgroup is the name of the great group.

SUBGROUP.—Each great group is divided into subgroups, one that represents the central (typic) concept of the group, and others called intergrades and extragrades. Intergrade subgroups have properties of the group and also one or more properties of another great group, suborder, or order. Extragrade subgroups have properties of the group and also some properties that are not diagnostic of another great group, suborder, or order.

FAMILY.—Families are established within each subgroup primarily on the basis of properties important to the growth of plants or the behavior of soils when used for engineering. Among the properties considered are

texture, mineralogy, reaction, soil temperature, permeability, depth, slope, consistence, and coatings.

SERIES.—The series is a group of soils that have major horizons that, except for texture of surface layer, are similar in important characteristics and in arrangement in the profile. A series is commonly given the name of a geographic location near the place where soils of that series were first observed and mapped.

General Nature of the County

In this section the climate of Shiawassee County and the farm statistics are discussed. The statistics are taken from the Bureau of the Census.

Climate [7]

The inland location of Shiawassee County away from the lakes lessens the influence of the lakes to some extent, but this influence has a considerable moderating effect on the climate. Prevailing westerly winds are cooled in summer and are warmed in winter as they cross Lake Michigan. Easterly and northeasterly winds are also moderated in crossing Lake Huron and Saginaw Bay. Winds from the south move long distances over land surfaces, unaffected by the lakes. Thus, there is a variation from a modified maritime to continental climate.

Data on temperature and precipitation are given in table 10. Available weather data for the county show that the highest temperature recorded was 105° F. on July 9, 1936, and the lowest was —20° on February 9, 1934 and February 20, 1929. An average winter has 5 days when the temperature is zero or below. At the other extreme, in about one summer in four, temperatures of 100° or higher have been recorded, and an average summer has 19 days when the temperature is 90° or higher.

In February 1936, the coldest month on record, the average temperature was 14.2°, and in August 1947, the warmest month on record, the average temperature was 76.5°. The average dates of the last freezing temperature in spring and the first freezing temperature in fall are May 12 and October 2, respectively. Probable dates of specified temperatures of 32° and lower are given in table 11.

Precipitation is heaviest during the growing season. Table 10 shows that an average of 60 percent of the annual total falls during the 6 months, April through September. The heaviest average precipitation is in June and the second heaviest in May. Further, the table shows that the month when the precipitation is lightest is January. The greatest amount of precipitation in a single month of record was 8.07 inches in September 1945, and the least amount in a single month was 0.22 inch in July 1930. The heaviest intensity of rainfall for a 24-hour period was 3.35 inches on September 4, 1932.

The average snowfall in Owosso is 37.2 inches, which is about the same as in other places in central Michigan but only about half that in the so-called Lake Michigan snow belt along the western side of the Lower Peninsula. On the average, 7 months of the year have measurable amounts of snow. The months of heaviest snowfall are January and February. In January the average is 9.0 inches and in February, is 8.3 inches. The heaviest snowfall reported in a single day was 11.0 inches on March 20, 1940.

[7] NORTON D. STROMMEN, climatologist for Michigan, National Weather Service, U.S. Department of Commerce, prepared this section.

TABLE 10.—*Temperature and precipitation data*

[Based on records at Owosso, Shiawassee County. Period of record, 1935–1964]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average total	One year in 10 will have—		Days with snow cover	Average depth of snow on days with snow cover
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than—	More than—		
	°F.	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Number*	*Inches*
January	32.6	17.1	47	−2	1.65	0.9	3.0	20	4.1
February	34.4	16.8	47	−3	1.71	.8	2.5	20	5.3
March	43.4	24.5	63	7	2.08	.9	3.0	9	4.1
April	57.6	34.6	81	22	2.79	1.0	4.4	1	2.2
May	69.7	45.3	84	32	3.24	1.2	5.9	0	0
June	79.9	55.5	90	42	3.66	1.9	5.1	0	0
July	84.9	59.7	94	48	2.65	1.1	4.1	0	0
August	82.9	57.7	93	46	3.08	1.6	5.3	0	0
September	75.1	50.9	88	36	2.58	1.4	4.0	0	0
October	63.7	40.9	80	28	2.13	.5	3.5	0	2.0
November	47.2	30.9	65	18	1.96	.5	3.2	3	2.6
December	35.5	21.4	52	3	1.70	.8	2.9	14	3.5
Year	58.9	37.9			29.23			67	

TABLE 11.—*Probabilities of low temperatures in spring and fall*

[Dates were calculated from records for the period 1935–1964]

Probability	Dates for given probability and temperature				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 7	April 17	May 1	May 17	May 27
2 years in 10 later than	April 2	April 12	April 26	May 12	May 22
5 years in 10 later than	March 23	April 2	April 16	May 2	May 12
Fall:					
1 year in 10 earlier than	November 13	November 2	October 20	October 3	September 16
2 years in 10 earlier than	November 18	November 7	October 25	October 8	September 21
5 years in 10 earlier than	November 29	November 18	November 5	October 19	October 2

Cloudiness is greatest late in fall and early in winter and least in spring and summer. The prevailing westerly air currents passing over Lake Michigan accentuate the cloudiness, especially late in fall. Temperature differences between the colder air and the relatively warm water are greater at that time, and result in the addition of warmth and moisture of the lower layers of the air, which causes instability, and later, condensation and cloudiness. Owosso is not affected by this condition as much as localities near Lake Michigan. The entire Lower Peninsula has increased cloudiness from this action during this period of the year, but also warmer temperatures than would normally occur at this latitude.

Farm Statistics

The total area of Shiawassee County is about 345,600 acres. Of this, about 84 percent, or 291,844 acres, is in farms. The rest is of State-owned land; privately owned woodland; abandoned farmland; and resort, urban, recreational, and industrial areas. Of the acreage in farms in 1964, about 62 percent, or 182,412 acres, were in harvested crops, and about 4 percent, or 13,907 acres, were in cropland used only for pasture.

There were 2,033 farms in the county in 1964. Of these farms, 422 were from 1 to 49 acres in size; 541 were from 50 to 99 acres; 769 were from 100 to 259 acres; 272 were from 260 to 499 acres; and 26 were from 500 to 999 acres. Only two farms were between 1,000 and 2,000 acres in size, and one farm was larger than 2,000 acres.

Of the 2,033 farms in the county, 705 were miscellaneous or unclassified; 416 were dairy farms; 142 were poultry and livestock farms other than dairy; and the rest were vegetable, field crop, fruit and nut, and general farms.

Corn is the chief row crop grown, and, in 1964, 37,433 acres of corn were harvested for grain and 6,560 acres were cut for silage. Small grain is also an important crop in the county, and in 1964 there were 34,158 acres of wheat, 15,366 acres of oats, 594 acres of barley, 1,109 acres of rye, and 1,031 acres of buckwheat. Soybeans are a major crop, and 25,274 acres were harvested. Of the hay crops harvested, 28,333 acres were alfalfa and alfalfa mixtures, 2,973 acres were clover or timothy, and 687 acres were other hay crops. Alfalfa and red clover were seeded on 936 acres; potatoes on 209 acres; field beans on 23,919 acres; tree fruits, nuts, and grapes on 235 acres. Vegetables were harvested for sale on 274 acres.

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Glossary

Aggregate. Many fine particles held in a single mass or cluster, such as a clod, a crumb, a block, or a prism.

Alluvium. Soil material that has been deposited on land by streams.

Available water capacity. The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. Also called available moisture capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: Clay coat, clay skin.

Coarse fragments. Mineral or rock particles more than 2 millimeters in diameter.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent; will not hold together in a mass.

Friable.—When moist, crushes easily under gentle to moderate pressure between thumb and forefinger and can be pressed together in a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a wire when rolled between thumb and forefinger.

Contour farming. Plowing, cultivating, planting, and harvesting in rows that are at right angles to the natural direction of the slope or that are parallel to the terrace grade.

Contour stripcropping. Growing crops in strips that follow the contour or are parallel to terraces or diversions. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cover crop. A close-growing crop grown primarily to improve the soil and to protect it between periods of regular crop production.

Diversion. Channel constructed across the slope for the purpose of intercepting runoff.

Drainage, artificial. The removal of excess water on or within the soil by means of surface or subsurface drains.

Drainage, natural. Refers to the conditions that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. The following five classes of natural drainage are recognized in Shiawassee County.

Well-drained soils are nearly free from mottling and are commonly of medium or coarse texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum; they have uniform color in the A horizon and the upper part of the B horizon and are mottled in the lower part of the B horizon and in the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time; the water table is within 12 to 24 inches of the surface during part of the year; mottling occurs at a depth below 6 to 16 inches, in the lower part of the A horizon and in the B and C horizons.

Poorly drained soils are wet for long periods; they are light gray and generally are mottled from the surface downward but may be free of mottling or nearly so.

Very poorly drained soils are wet nearly all the time; they have a dark-gray or black surface layer and are black, gray, or light gray, with or without mottling, in the lower part of the profile.

Fertility, soil. The quality of a soil that enables it to provide compounds, in adequate amounts and in proper balance, for the growth of specified plants, when other growth factors, such as light, moisture, temperature, and the physical condition of the soil, are favorable.

Flood plain. Nearly level land, consisting of stream sediments, that borders a stream and is subject to flooding unless protected artificially.

Glaciofluvial deposits. Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice; the deposits are stratified and occur in the form of kames, eskers, deltas, and outwash plains.

Gravel. Rounded pebbles 2 millimeters to 3 inches in diameter. A gravelly soil is 15 to 50 percent gravel.

Green manure. A crop grown for the purpose of being turned under in an early stage of maturity or soon after maturity for soil improvement.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residue.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of the following: soluble salts, clay, or sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sequioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Micronutrient. A chemical element needed in very small amounts for growth of plants. Boron, copper, iron, manganese, and zinc are examples. "Micro" refers to amount needed, not to essentiality.

Mineral soil. Soil composed mainly of inorganic (mineral) material and low in content of organic matter. Its bulk density is greater than that of an organic soil.

Minimum tillage. The amount of tillage needed to create proper conditions for germination of seed, establishment of plants, and control of competing vegetation.

Mottled. Irregularly marked with spots of a different color. Mottles vary in number and size. Their presence usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: *abundance*—few, common, and many; *size*—fine, medium, and coarse; and *contrast*—faint, distinct, and prominent. The size measurements are these: *fine*, less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium*, ranging from 5 millimeters to 15 millimeters (about 0.2 to about 0.6 inch) in diameter along the greatest dimension; and *coarse*, more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Muck. An organic soil consisting of well-decomposed organic material that is finely divided, and dark colored.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color that has a hue of 10YR, a value of 6, and a chroma of 4.

Organic matter. A general term for plant and animal material, in or on the soil, in all stages of decomposition. Readily decomposed organic matter is often distinguished from the more stable forms that are past the stage of rapid decomposition.

Organic soil. A general term applied to a soil or to a soil horizon that consists primarily of organic matter, such as peat soils, muck soils, and peaty soil layers.

Peat. Unconsolidated soil material, largely undecomposed organic matter that has accumulated where there has been excess moisture.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: very slow, slow, moderately slow, moderate, moderately rapid, rapid, and very rapid.

Percolation. The downward movement of water through soil.

Piping. Removal of soil material through subsurface flow channels (pipes) formed by seepage water.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed as a pH value. A pH of 7.0 indicates a neutral reaction; a higher pH indicates alkalinity, and a lower pH, acidity. The various degrees of acidity and alkalinity are expressed in words as follows:

	pH		pH
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Runoff. Water that flows off the land surface and into streams without sinking into the soil.

Sand. As a soil separate, individual rock or mineral fragments that range from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz, but sand may be of any mineral composition. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope. The inclination of the land surface from the horizontal. To get the percentage of slope, divide the vertical distance by the horizontal distance and multiply by 100. Thus, a slope of 10 percent is a drop of 10 feet in 100 feet of horizontal distance.

Soil. A natural three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief, over periods of time.

Soil separates. Mineral particles, less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: very coarse sand (2.0 millimeters to 1.0 millimeter); coarse sand (1.0 to 0.5 millimeter); medium sand (0.5 to 0.25 millimeter); fine sand (0.25 to 0.10 millimeter); very fine sand (0.10 to 0.05 millimeter); silt (0.05 to 0.002 millimeter); and clay (less than 0.002 millimeter).

Stratified. Composed of, or arranged in, strata, or layers, such as stratified alluvium. The term is limited to geologic material. Layers that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), blocky (angular or subangular), and granular. Structureless soils are (1) single grain (each grain by itself, as in dune sand) or (2) massive (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Subsurface layer. As used in this survey, that part of the A horizon that is directly below the surface layer. It is leached of soluble minerals and clay.

Surface layer. As used in this survey, that part of the A horizon that occurs at the surface. This layer contains an accumulation of organic matter and generally is dark colored.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Texture soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles, are as follows: sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Upland (geology). Land consisting of material unworked by water in recent geologic time and lying, in general, at a higher elevation than the alluvial plain or stream terrace. Land above the lowlands along rivers.

Valley train. A long, narrow body of outwash confined within a valley.

Variant. A soil sufficiently unlike those of any established series to justify a new series name but, because of limited extent, given the name of an established series it closely resembles.

Very stony. Of a soil, containing enough stones to make the production of intertilled crops impracticable.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table is separated from a lower one by a dry zone.

Woodland. Land used primarily for growing trees and shrubs. In addition to what is ordinarily called forest or forest plantations, it includes shelterbelts, windbreaks, wide hedgerows of plants that supply food and cover for wildlife, and streambanks and other slopes that have woodland cover.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit, a woodland suitability group, or a recreation group, read the introduction to the section it is in for general information about its management. The symbol in parentheses following the capability unit symbol shows the soil management group of the Michigan State system in which the mapping unit belongs. Other information is given in tables as follows:

Acreage and extent, table 1, page 7.
Predicted yields, table 2, page 57.
Use of soils for wildlife, table 4, page 64.

Engineering uses of the soils, table 5, page 70, and tables 6, 7, and 8, pages 74 through 105.

Map symbol	Mapping unit	Page	Capability unit		Woodland suitability group		Recreation group	
			Symbol	Page	Symbol	Page	Number	Page
Ah	Algansee sandy loam	8	VIIw-1 (L-4c)	56	0	62	6	68
Ba	Barry loam	9	IIw-6 (3c)	51	W	62	4	68
Bb	Barry sandy loam, bedrock variant	9	IIw-6 (3/Rc)	51	W	62	4	68
Bc	Barry stony loam	9	IIw-6 (3c)	51	W	62	4	68
BeA	Belding sandy loam, 0 to 2 percent slopes	10	IIw-8 (3/2b)	52	G	61	3	68
Bh	Berville loam	11	IIw-4 (3/2c)	51	P	62	4	68
BmA	Boyer loamy sand, 0 to 2 percent slopes	12	IIIs-4 (4a)	53	C	60	1	66
BmB	Boyer loamy sand, 2 to 6 percent slopes	12	IIIs-4 (4a)	53	C	60	1	66
BmC	Boyer loamy sand, 6 to 12 percent slopes	12	IIIe-9 (4a)	53	C	60	1	66
BmD	Boyer loamy sand, 12 to 18 percent slopes	12	IVe-9 (4a)	54	C	60	1	66
BmE	Boyer loamy sand, 18 to 25 percent slopes	12	VIe-2 (4a)	56	C	60	1	66
BoB	Boyer very stony loamy sand, 2 to 6 percent slopes	12	VIe-2 (4a)	56	C	60	1	66
BrA	Boyer sandy loam, 0 to 2 percent slopes	13	IIIs-4 (4a)	53	C	60	1	66
BrB	Boyer sandy loam, 2 to 6 percent slopes	13	IIIs-4 (4a)	53	C	60	1	66
BrC	Boyer sandy loam, 6 to 12 percent slopes	13	IIIe-9 (4a)	53	C	60	1	66
BrD	Boyer sandy loam, 12 to 18 percent slopes	13	IVe-9 (4a)	54	C	60	1	66
Bt	Breckenridge sandy loam	14	IIw-8 (3/2c)	52	W	62	4	68
Bv	Brevort loamy sand	14	IIIw-9 (4/2c)	53	W	62	4	68
Bw	Brookston loam	15	IIw-4 (2.5c)	51	P	62	4	68
Cg	Carlisle muck	16	IIIw-15 (Mc)	53	J	61	7	69
ChB	Celina loam, 2 to 6 percent slopes	17	IIe-2 (2.5a)	51	D	61	2	67
ChB2	Celina loam, 2 to 6 percent slopes, moderately eroded	17	IIe-2 (2.5a)	51	D	61	2	67
Cm	Ceresco loam	17	Vw-3 (L-2c)	56	O	62	6	68
Cn	Cohoctah loam	18	Vw-3 (L-2c)	56	O	62	6	68
Cs	Colwood loam	19	IIw-6 (2.5c)	51	W	62	4	68
CtA	Conover loam, 0 to 2 percent slopes	20	IIw-4 (2.5b)	51	Z	63	3	68
CtB	Conover loam, 2 to 6 percent slopes	20	IIw-5 (2.5b)	51	Z	63	3	68
Ek	Edwards muck	20	IVw-6 (M/mc)	55	J	61	7	69
En	Eel, Landes, and Abscota soils	21	Vw-3 (L-2a, L-4a)	56	O	62	6	68
FoB	Fox sandy loam, 2 to 6 percent slopes	22	IIe-3 (3a)	51	U	62	2	67
FoC	Fox sandy loam, 6 to 12 percent slopes	22	IIIe-6 (3a)	52	U	62	2	67
FoD	Fox sandy loam, 12 to 18 percent slopes	22	IVe-4 (3a)	54	U	62	2	67
Gg	Gilford sandy loam	23	IIIw-6 (4c)	53	W	62	4	68
Gh	Gilford stony sandy loam	23	Vw-1 (4c)	55	W	62	4	68
GmA	Gladwin loamy sand, 0 to 2 percent slopes	24	IIIw-5 (4b)	53	G	61	5	68
Gn	Glendora sandy loam	24	VIIw-1 (L-4c)	56	O	62	6	68
Go	Granby loamy sand	25	IIIw-6 (5c)	53	W	62	4	68
Gp	Gravel pits	25	VIIIs-1 (Sa)	56	--	--	--	--
IsA	Iosco loamy sand, 0 to 2 percent slopes	26	IIIw-9 (4/2b)	53	G	61	5	68
ItA	Iosco stony loamy sand, 0 to 2 percent slopes	26	Vw-1 (4/2b)	55	G	61	5	68
Iv	Iosco loamy sand, deep variant	27	IIIw-9 (4/2b)	53	G	61	5	68
KhB	Kendallville sandy loam, 2 to 6 percent slopes	27	IIe-2 (3/2a)	51	D.	61	2	67
KhB2	Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded	27	IIe-2 (3/2a)	51	D	61	2	67
KhC	Kendallville sandy loam, 6 to 12 percent slopes	28	IIIe-5 (3/2a)	52	D	61	2	67
KhC2	Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded	28	IIIe-5 (3/2a)	52	D	61	2	67
KnA	Kibbie loam, 0 to 2 percent slopes	28	IIw-6 (2.5b)	51	G	61	3	68
KnB	Kibbie loam, 2 to 6 percent slopes	28	IIw-7 (2.5b)	52	G	61	3	68
LmB	Lapeer sandy loam, 2 to 6 percent slopes	29	IIe-3 (3a)	51	U	62	2	67
LmC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded	30	IIIe-6 (3a)	52	U	62	2	67
Ln	Lenawee silt loam	30	IIw-4 (1.5c)	51	P	62	4	68
Lo	Linwood muck	31	IIw-10 (M/3c)	52	J	61	7	69
LsA	Locke sandy loam, 0 to 2 percent slopes	32	IIw-6 (3b)	51	G	61	3	68
LsB	Locke sandy loam, 2 to 6 percent slopes	32	IIw-7 (3b)	52	G	61	3	68
MaA	Macomb loam, 0 to 2 percent slopes	33	IIw-4 (3/2b)	51	Z	63	3	68
MbB	Macomb sandy loam, 2 to 6 percent slopes	33	IIw-5 (3/2b)	51	Z	63	3	68
Md	Made land	33	VIIIs-1 (Sa)	56	--	--	--	--
MeA	Mancelona loamy sand, 0 to 2 percent slopes	34	IIIs-4 (4a)	53	C	60	1	66
MeB	Mancelona loamy sand, 2 to 6 percent slopes	34	IIIs-4 (4a)	53	C	60	1	66
MmA	Matherton sandy loam, 0 to 2 percent slopes	35	IIw-6 (3b)	51	G	61	3	68
MmB	Matherton sandy loam, 2 to 6 percent slopes	35	IIw-7 (3b)	52	G	61	3	68
MnA	Matherton sandy loam, loamy substratum, 0 to 2 percent slopes	35	IIw-8 (3/2b)	52	G	61	3	68
MnB	Matherton sandy loam, loamy substratum, 2 to 6 percent slopes	35	IIw-8 (3/2b)	52	G	61	3	68
MoB	Menominee loamy sand, 2 to 6 percent slopes	36	IIIs-4 (4/2a)	53	C	60	1	66
MoC	Menominee loamy sand, 6 to 12 percent slopes	36	IIIe-9 (4/2a)	53	C	60	1	66
MrA	Metamora loamy sand, 0 to 2 percent slopes	37	IIw-8 (3/2b)	52	G	61	3	68
MsA	Metamora sandy loam, 0 to 2 percent slopes	37	IIw-8 (3/2b)	52	G	61	3	68
MsB	Metamora sandy loam, 2 to 6 percent slopes	37	IIw-8 (3/2b)	52	G	61	3	68
MuB	Miami loam, 2 to 6 percent slopes	38	IIe-2 (2.5a)	51	D	61	2	67
MuB2	Miami loam, 2 to 6 percent slopes, moderately eroded	38	IIe-2 (2.5a)	51	D	61	2	67
MuC	Miami loam, 6 to 12 percent slopes	38	IIIe-5 (2.5a)	52	D	61	2	67
MuC2	Miami loam, 6 to 12 percent slopes, moderately eroded	38	IIIe-5 (2.5a)	52	D	61	2	67
MuD2	Miami loam, 12 to 18 percent slopes, moderately eroded	38	IVe-4 (2.5a)	54	D	61	2	67
MuE2	Miami loam, 18 to 25 percent slopes, moderately eroded	39	VIe-2 (2.5a)	56	D	61	2	67
MvD3	Miami clay loam, 12 to 18 percent slopes, severely eroded	39	VIe-2 (2.5a)	56	D	61	2	67
Mw	Mine pits	39	VIIIs-1 (Sa)	56	--	--	--	--
NyB	Newaygo sandy loam, 2 to 6 percent slopes	39	IIe-3 (3a)	51	U	62	2	67
OkA	Ottokee loamy sand, 0 to 2 percent slopes	40	IIIs-4 (5a)	53	E	61	1	66
OmB	Owosso-Miami sandy loams, 2 to 6 percent slopes	41	IIe-3 (3/2a-2.5a)	51	D	61	2	67
OmC	Owosso-Miami sandy loams, 6 to 12 percent slopes	41	IIIe-6 (3/2a-2.5a)	52	D	61	2	67
OmD2	Owosso-Miami sandy loams, 12 to 18 percent slopes, moderately eroded	41	IVe-4 (3/2a-2.5a)	54	D	61	2	67
PfB	Plainfield loamy sand, slightly acid variant, 2 to 6 percent slopes	42	VIs-1 (5a)	56	E	61	1	66
PfC	Plainfield loamy sand, slightly acid variant, 6 to 12 percent slopes	42	VIs-1 (5a)	56	E	61	1	66
RhA	Richter loamy fine sand, 0 to 2 percent slopes	43	IIw-6 (3b)	51	G	61	3	68
Sd	Sebewa loam	44	IIw-6 (3c)	51	W	62	4	68
Sh	Shoals loam	44	Vw-3 (L-2c)	56	O	62	6	68
Sn	Sloan loam	45	Vw-3 (1-2c)	56	O	62	6	68
SpA	Spinks loamy sand, 0 to 2 percent slopes	45	IIIs-4 (4a)	53	E	61	1	66
SpB	Spinks loamy sand, 2 to 6 percent slopes	46	IIIs-4 (4a)	53	E	61	1	66
SpC	Spinks loamy sand, 6 to 12 percent slopes	46	IIIe-9 (4a)	53	E	61	1	66
SpD	Spinks loamy sand, 12 to 18 percent slopes	46	IVe-9 (4a)	54	E	61	1	66
Ta	Tawas muck	47	IVw-5 (M/4c)	54	J	61	7	69
TsB	Tuscola loam, 2 to 6 percent slopes	47	IIe-2 (2.5a)	51	U	62	2	67
Wa	Wallkill loam	48	Vw-3 (L-2c)	56	J	61	7	69
WeA	Wasepi sandy loam, 0 to 2 percent slopes	48	IIIw-5 (4b)	53	G	61	3	68
WeB	Wasepi sandy loam, 2 to 6 percent slopes	49	IIIw-5 (4b)	53	G	61	3	68

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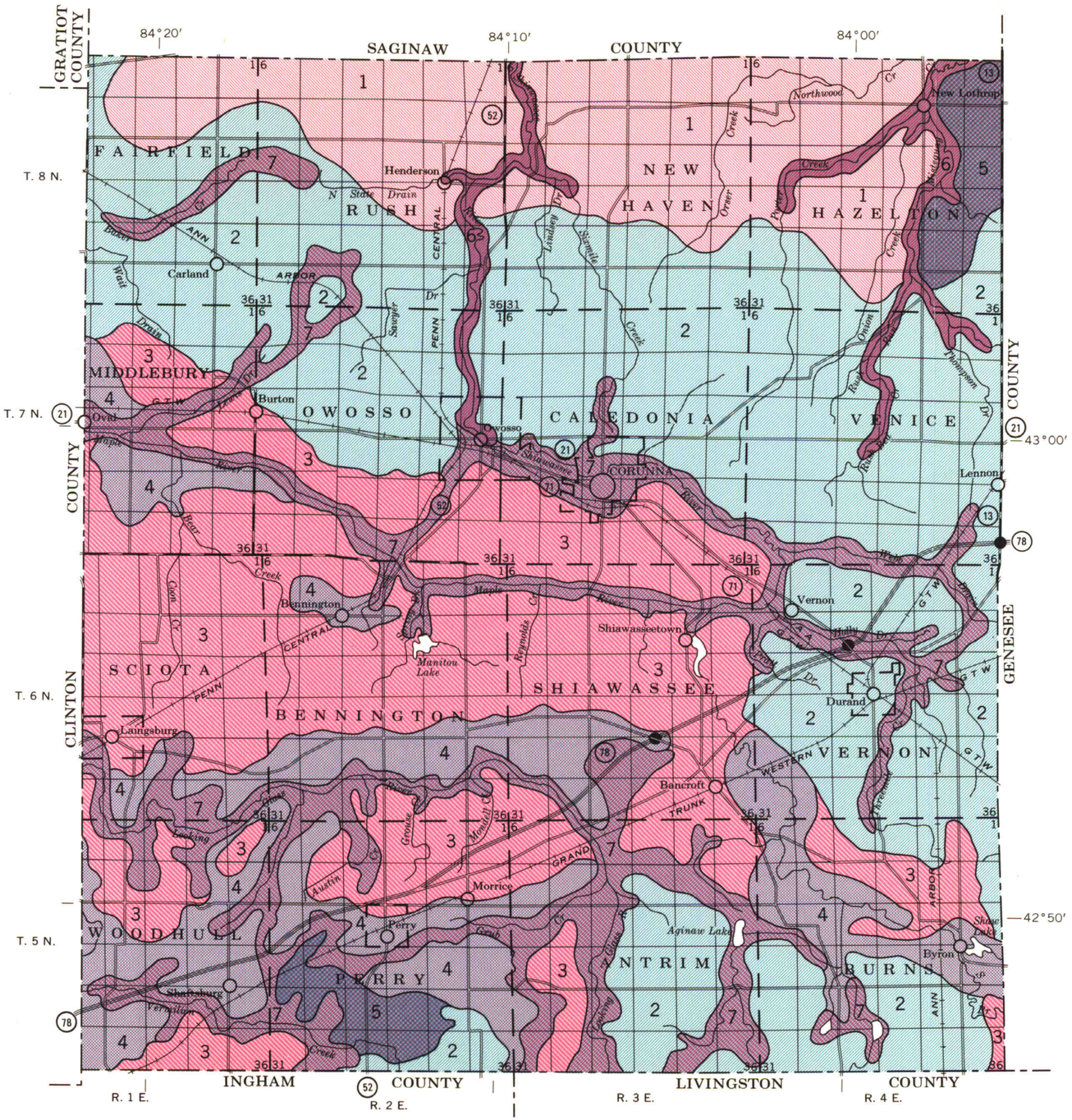


U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

MICHIGAN AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

SHIAWASSEE COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

N

SOIL ASSOCIATIONS *

1 — Brookston-Berville-Conover association: Poorly drained and somewhat poorly drained, nearly level, loamy soils on till plains

2 — Conover-Brookston association: Somewhat poorly drained and poorly drained, nearly level to gently sloping, loamy soils on till plains

3 — Miami-Conover-Brookston association: Well-drained to poorly drained, nearly level to steep, loamy soils on till plains and moraines

4 — Boyer-Wasepi-Spinks association: Well-drained and somewhat poorly drained, nearly level to steep, sandy and loamy soils on outwash plains, terraces, and moraines

5 — Kibbie-Colwood-Lenawee association: Somewhat poorly drained and poorly drained, nearly level to gently sloping, loamy soils on lake plains

6 — Ceresco-Cohoctah-Sloan association: Somewhat poorly drained and poorly drained, nearly level, loamy soils on flood plains

7 — Carlisle-Gilford-Tawas association: Very poorly drained and poorly drained, nearly level, mucky and loamy soils on outwash plains and in glacial drainageways

* The texture given in the descriptive heading refers to that of the surface layer of the major soils in each association.

Compiled 1972

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

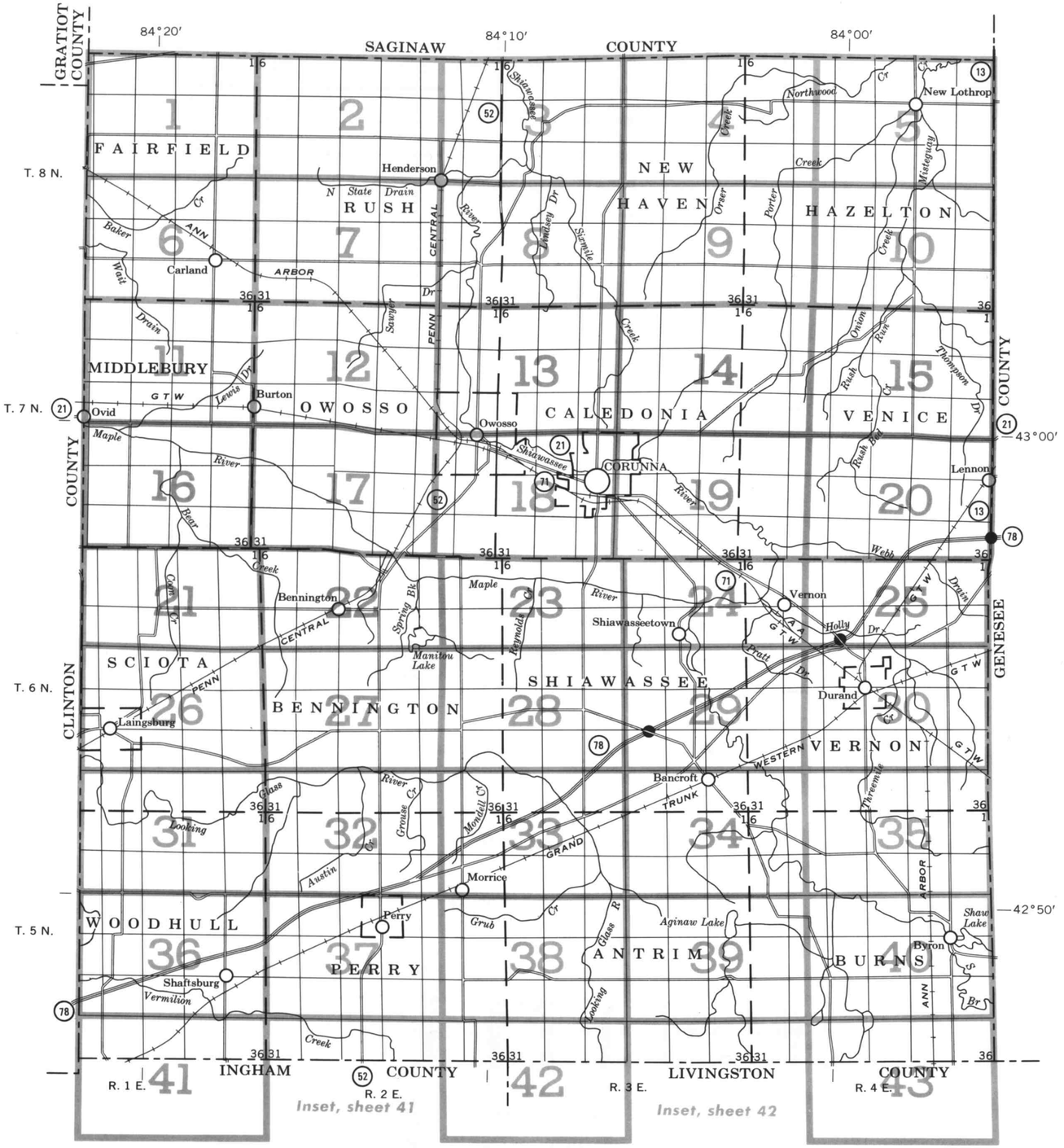
INDEX TO MAP SHEETS

SHIAWASSEE COUNTY, MICHIGAN

Scale 1:190,080

1 0 1 2 3 4 Miles

N



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHIAWASSEE COUNTY, MICHIGAN

MICHIGAN AGRICULTURAL EXPERIMENT STATION

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, or E, shows the slope. Most symbols without a slope letter are those of nearly level soils, but some are for land types that have a considerable range in slope. A final number, 2 or 3, in the symbol shows that the soil is moderately eroded or severely eroded.

SYMBOL	NAME
Ah	Algansee sandy loam
Ba	Barry loam
Bb	Barry sandy loam, bedrock variant
Bc	Barry stony loam
BeA	Belding sandy loam, 0 to 2 percent slopes
Bh	Berville loam
BmA	Boyer loamy sand, 0 to 2 percent slopes
BmB	Boyer loamy sand, 2 to 6 percent slopes
BmC	Boyer loamy sand, 6 to 12 percent slopes
BmD	Boyer loamy sand, 12 to 18 percent slopes
BmE	Boyer loamy sand, 18 to 25 percent slopes
BoB	Boyer very stony loamy sand, 2 to 6 percent slopes
BrA	Boyer sandy loam, 0 to 2 percent slopes
BrB	Boyer sandy loam, 2 to 6 percent slopes
BrC	Boyer sandy loam, 6 to 12 percent slopes
BrD	Boyer sandy loam, 12 to 18 percent slopes
Bt	Breckenridge sandy loam
Bv	Brevort loamy sand
Bw	Brookston loam
Cg	Carlisle muck
ChB	Celina loam, 2 to 6 percent slopes
ChB2	Celina loam, 2 to 6 percent slopes, moderately eroded
Cm	Ceresco loam
Cn	Cohoctah loam
Cs	Colwood loam
CtA	Conover loam, 0 to 2 percent slopes
CtB	Conover loam, 2 to 6 percent slopes
Ek	Edwards muck
En	Eel, Landes, and Abscota soils
FoB	Fox sandy loam, 2 to 6 percent slopes
FoC	Fox sandy loam, 6 to 12 percent slopes
FoD	Fox sandy loam, 12 to 18 percent slopes
Gg	Gilford sandy loam
Gh	Gilford stony sandy loam
GmA	Gladwin loamy sand, 0 to 2 percent slopes
Gn	Glendora sandy loam
Go	Granby loamy sand
Gp	Gravel pits
IsA	Iosco loamy sand, 0 to 2 percent slopes
ItA	Iosco stony loamy sand, 0 to 2 percent slopes
Iv	Iosco loamy sand, deep variant
KhB	Kendallville sandy loam, 2 to 6 percent slopes
KhB2	Kendallville sandy loam, 2 to 6 percent slopes, moderately eroded
KhC	Kendallville sandy loam, 6 to 12 percent slopes
KhC2	Kendallville sandy loam, 6 to 12 percent slopes, moderately eroded
KnA	Kibbie loam, 0 to 2 percent slopes
KnB	Kibbie loam, 2 to 6 percent slopes
LmB	Lapeer sandy loam, 2 to 6 percent slopes
LmC2	Lapeer sandy loam, 6 to 12 percent slopes, moderately eroded
Ln	Lenawee silt loam
Lo	Linwood muck
LsA	Locke sandy loam, 0 to 2 percent slopes
LsB	Locke sandy loam, 2 to 6 percent slopes
MaA	Macomb loam, 0 to 2 percent slopes
MbB	Macomb sandy loam, 2 to 6 percent slopes
Md	Made land
MeA	Mancelona loamy sand, 0 to 2 percent slopes
MeB	Mancelona loamy sand, 2 to 6 percent slopes
MmA	Matherton sandy loam, 0 to 2 percent slopes
MmB	Matherton sandy loam, 2 to 6 percent slopes
MnA	Matherton sandy loam, loamy substratum, 0 to 2 percent slopes
MnB	Matherton sandy loam, loamy substratum, 2 to 6 percent slopes
MoB	Menominee loamy sand, 2 to 6 percent slopes
MoC	Menominee loamy sand, 6 to 12 percent slopes
MrA	Metamora loamy sand, 0 to 2 percent slopes
MsA	Metamora sandy loam, 0 to 2 percent slopes
MsB	Metamora sandy loam, 2 to 6 percent slopes
MuB	Miami loam, 2 to 6 percent slopes
MuB2	Miami loam, 2 to 6 percent slopes, moderately eroded
MuC	Miami loam, 6 to 12 percent slopes
MuC2	Miami loam, 6 to 12 percent slopes, moderately eroded
MuD2	Miami loam, 12 to 18 percent slopes, moderately eroded
MuE2	Miami loam, 18 to 25 percent slopes, moderately eroded
MvD3	Miami clay loam, 12 to 18 percent slopes, severely eroded
Mw	Mine pits
NyB	Newaygo sandy loam, 2 to 6 percent slopes
OkA	Ottokee loamy sand, 0 to 2 percent slopes
OmB	Owosso-Miami sandy loams, 2 to 6 percent slopes
OmC	Owosso-Miami sandy loams, 6 to 12 percent slopes
OmD2	Owosso-Miami sandy loams, 12 to 18 percent slopes, moderately eroded
PfB	Plainfield loamy sand, slightly acid variant, 2 to 6 percent slopes
PfC	Plainfield loamy sand, slightly acid variant, 6 to 12 percent slopes
RhA	Richter loamy fine sand, 0 to 2 percent slopes
Sd	Sebewa loam
Sh	Shoals loam
Sn	Sloan loam
SpA	Spinks loamy sand, 0 to 2 percent slopes
SpB	Spinks loamy sand, 2 fo 6 percent slopes
SpC	Spinks loamy sand, 6 to 12 percent slopes
SpD	Spinks loamy sand, 12 to 18 percent slopes
Ta	Tawas muck
TsB	Tuscola loam, 2 to 6 percent slopes
Wa	Wallkill loam
WeA	Wasepi sandy loam, 0 to 2 percent slopes
WeB	Wasepi sandy loam, 2 to 6 percent slopes

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions

	Large	Small
Crossable with tillage implements		
Not crossable with tillage implements		
Contains water most of the time		

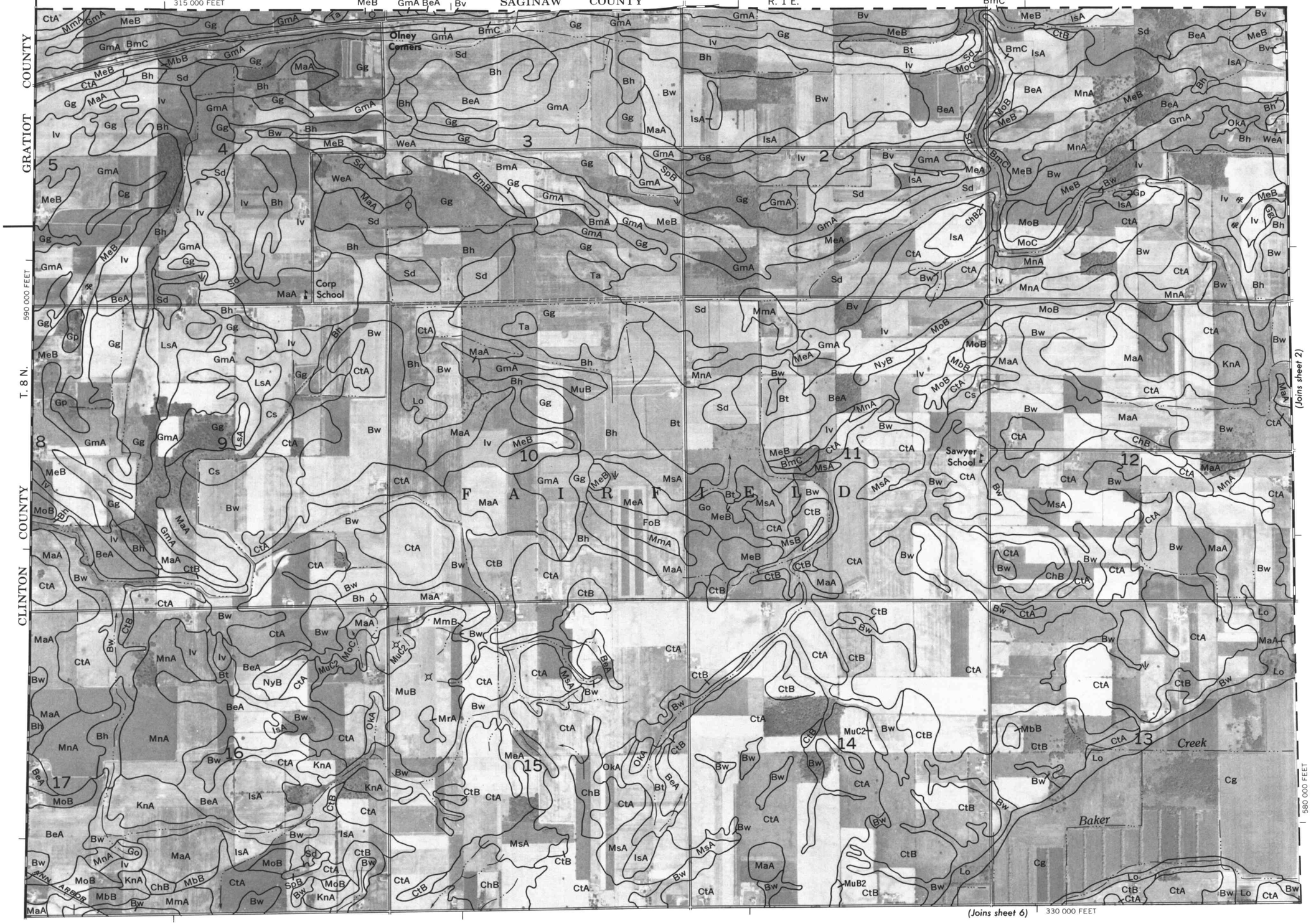
SOIL SURVEY DATA

- Soil boundary and symbol (Dx)
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Up to 1½ acres, well or moderately well drained, loamy sand or sandy loam soil
- Up to 1½ acres, somewhat poorly drained, loamy sand or sandy loam soil
- Up to 1½ acres of mineral soil in an area of organic soil
- Up to 1½ acres of organic soil in an area of mineral soil

SHIAWASSEE COUNTY, MICHIGAN — SHEET NUMBER 1

SHIAWASSEE COUNTY, MICHIGAN NO. 1

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.



2

N

SAGINAW COUNTY

R. 2 E.

355 000 FEET

590 000 FEET

T. 8 N.

580 000 FEET

335 000 FEET

(Joins sheet 1)

(Joins sheet 3)

(Joins sheet 7)

1 Mile

5 000 Feet

Scale 1:20000

0 0 ¼ 1000 ½ 2000 ¾ 4000 1 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 2

SHIAWASSEE COUNTY, MICHIGAN NO. 3

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

SHIAWASSEE COUNTY, MICHIGAN — SHEET NUMBER 4

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

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SHIAWASSEE COUNTY, MICHIGAN NO. 4

SHIAWASSEE COUNTY, MICHIGAN NO. 5

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

410 000 FEET

R. 4 E.

SAGINAW COUNTY

520 000 FEET

T. 8 N.

(Joins sheet 4)

New Lothrop

Hazelton

GENESEE COUNTY

580 000 FEET

425 000 FEET

(Joins sheet 10)

5

N

1 Mile

5000 Feet

Scale 1:20000

SHIAWASSEE COUNTY, MICHIGAN — SHEET NUMBER 6

6

N

(Joins sheet 1)

R. 1 E.

330 000 FEET

575 000 FEET

T. 8 N.

(Joins sheet 7)

565 000 FEET

315 000 FEET

(Joins sheet 11)

CLINTON COUNTY

1 Mile

5000 Feet

Scale · 1:20000

0 0

1/4 1000

1/2 2000

3/4 3000

4000

1 5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 6

SHIAWASSEE COUNTY, MICHIGAN NO. 7

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

N

R. 2 E.

335 000 FEET

575 000 FEET

T. 8 N

565 000 FEET

355 000 FEET

(Joins sheet 2)
(Joins sheet 6)
(Joins sheet 8)
(Joins sheet 12)

North State Drain
Drain
Gallagher Drain
Sanger Drain
Wolf Crossing
ANN ARBOR RAILROAD
PENN CENTRAL

19 20 21 22 23
30 29 28 27 26
31 32 33 34 35

1 Mile
5 000 Feet
Scale 1:20000
0 ¼ ½ ¾ 1
0 1 000 2 000 3 000 4 000 5000

8

N

1 Mile

5000 Feet

0

Scale 1:20000

¼ 1000

½ 2000

¾ 3000

1 4000

5000

380 000 FEET

575 000 FEET

565 000 FEET

360 000 FEET

R. 2 E. | R. 3 E.

T. 8 N.

Henderson

(Joins sheet 3)

(Joins sheet 7)

(Joins sheet 9)

(Joins sheet 13)

SHIAWASSEE RIVER

CENTRAL PENN RUSH

Drain

Creek

Land division corners are approximately positioned on this map.

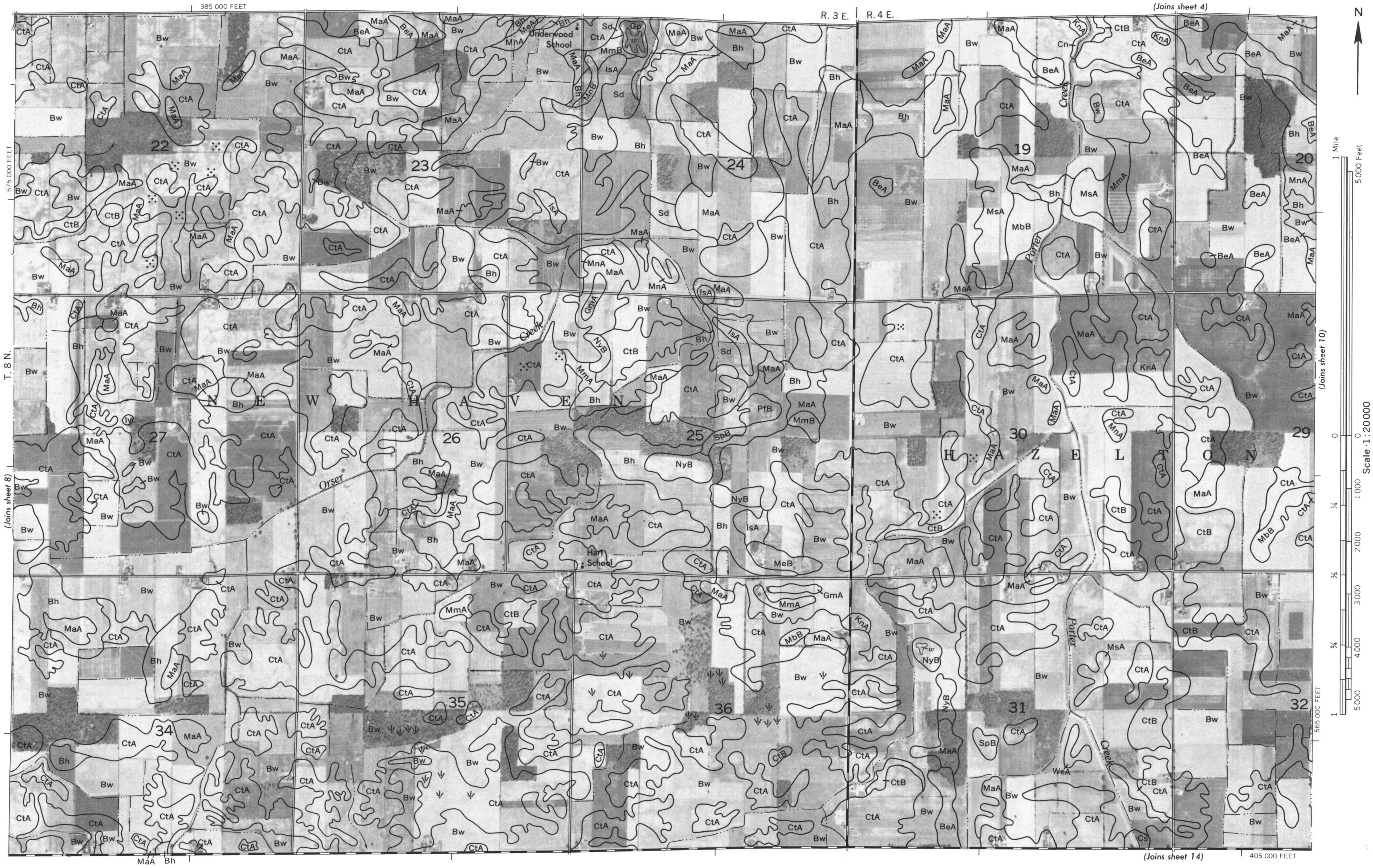
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 8

SHIAWASSEE COUNTY, MICHIGAN NO. 9

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.



10

N

(Joins sheet 5)

R. 4 E.

425 000 FEET

575 000 FEET

T. 8 N.

(Joins sheet 9)

565 000 FEET

(Joins sheet 15)

410 000 FEET

Hazelton

Juddville

Onion Creek

Mistequay Creek

Thompson Run Drain

Rush Sh Drain

HAZELTON

GENESEE COUNTY

1 Mile

5000 Feet

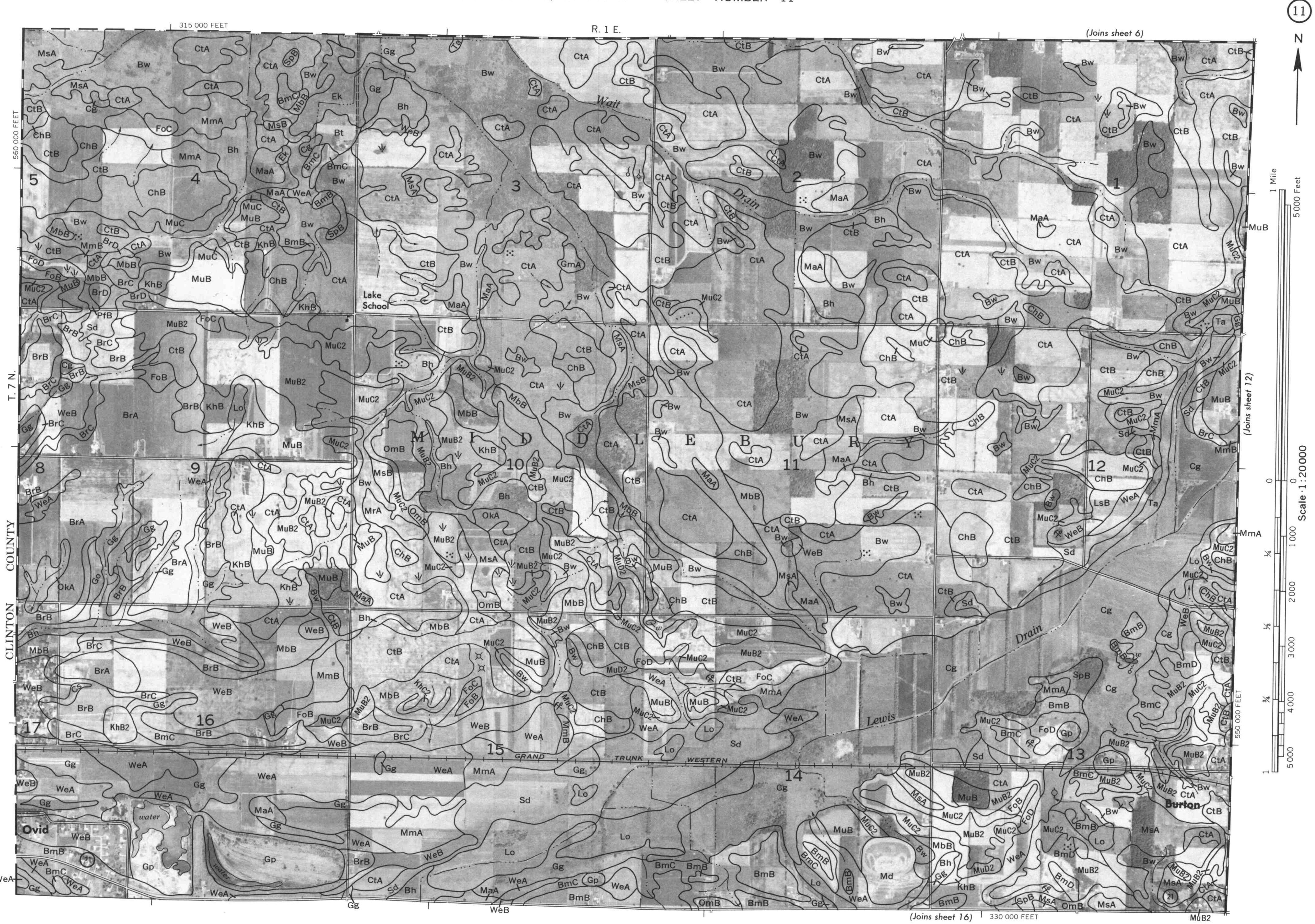
Scale 1:20000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 10



SHIAWASSEE COUNTY, MICHIGAN NO. 11

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone. Land division corners are approximately positioned on this map.

N

(Joins sheet 7)

R. 2 E.

355 000 FEET

1 Mile

5000 Feet

Scale 1:20000

560 000 FEET

T. 7 N.

(Joins sheet 11)

(Joins sheet 13)

Smith Crossing

Burton

335 000 FEET

(Joins sheet 17)

GRAND TRUNK WESTERN

ANN ARBOR

CENTRAL

PENN

Drain

Sawyer

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 12

SHIAWASSEE COUNTY, MICHIGAN NO. 13

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

360 000 FEET

R. 2 E. | R. 3 E.

(Joins sheet 8)

560 000 FEET

T. 7 N.

(Joins sheet 12)

(Joins sheet 14)

(Joins sheet 18)

550 000 FEET

380 000 FEET

OWOSSO

SHIAWASSEE RIVER

CLINTON

Sixmile Creek

Penn Central

Penn Central

Ann Arbor

N

1 Mile

5000 Feet

0

Scale 1:20000

1 5000 | ¾ 4000 | ½ 3000 | ¼ 2000 | 0 1000

SHIAWASSEE COUNTY, MICHIGAN — SHEET NUMBER 14

14

N

R. 3 E. | R. 4 E.

405 000 FEET

560 000 FEET

T. 7 N.

(Joins sheet 9)

(Joins sheet 13)

(Joins sheet 15)

(Joins sheet 19)

385 000 FEET

550 000 FEET

1 Mile

5000 Feet

Scale 1:20000

CALEDONIA

VENICE

Porter

Creek

Onion Creek

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

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SHIAWASSEE COUNTY, MICHIGAN NO. 14

SHIAWASSEE COUNTY, MICHIGAN NO. 15

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

410 000 FEET

R. 4 E.

(Joins sheet 10)

560 000 FEET

T. 7 N.

(Joins sheet 14)

GENESEE COUNTY

Onion Creek

Rush Creek

Rush Creek

Bad Creek

Thompson Drain

425 000 FEET

(Joins sheet 20)

550 000 FEET

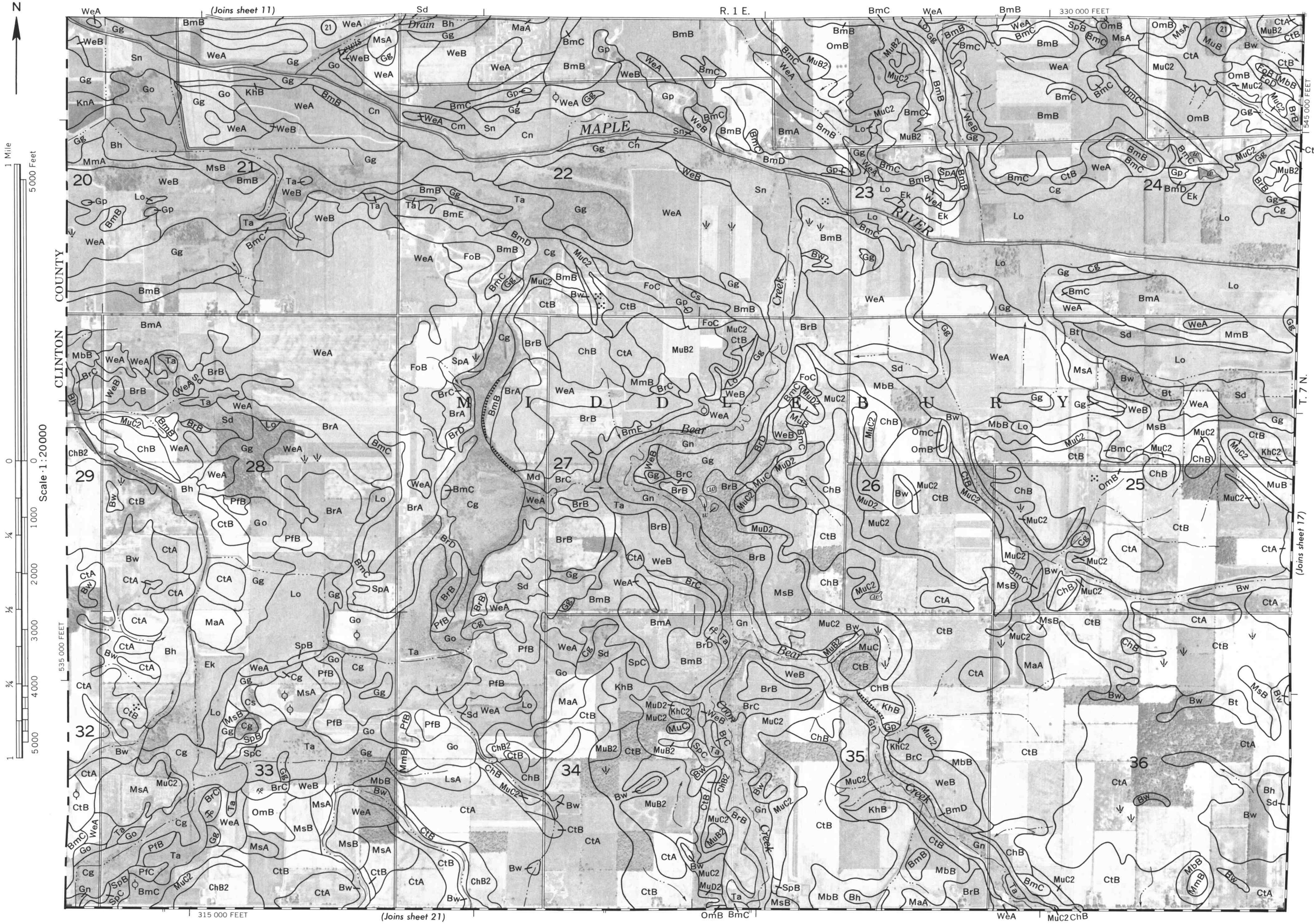
N

1 Mile

5000 Feet

Scale 1:20000

SHIAWASSEE COUNTY, MICHIGAN — SHEET NUMBER 16



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

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SHIAWASSEE COUNTY, MICHIGAN SHEET NO. 17

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

17

N

1 Mile
5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1
0 1000 2000 3000 4000 5000

18

N

1 Mile 5000 Feet

Scale 1:20000

(Joins sheet 13) R. 2 E. | R. 3 E. 380 000 FEET

545 000 FEET

T. 7 N.

535 000 FEET

(sheet 22) | (Joins sheet 23) 360 000 FEET

(Joins sheet 17)

(Joins sheet 19)

SHIAWASSEE COUNTY AIRPORT

OWOSSO

CORUNNA (county seat)

SHIAWASSEE RIVER

HOPKINS LAKE

ST PAUL CEMETERY

HILLCREST CEMETERY

CEMETERY

ANN ARBOR GRAND TRUNK WESTERN

PENN CENTRAL

OWOSSO CHARTER TOWNSHIP

CALEDONIA

CORUNNA

water

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 18

SHIAWASSEE COUNTY, MICHIGAN NO. 19

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

19

N

385 000 FEET

545 000 FEET

R. 3 E. | R. 4 E.

(Joins sheet 14)

(Joins sheet 18)

(Joins sheet 20)

535 000 FEET

405 000 FEET

(sh 23) | (Joins sheet 24)

(25)

T. 7 N.

CORUNNA
(county seat)

ANN ARBOR

SHIAWASSEE RIVER

Porter Creek

Hathan Drain

Hawkins School

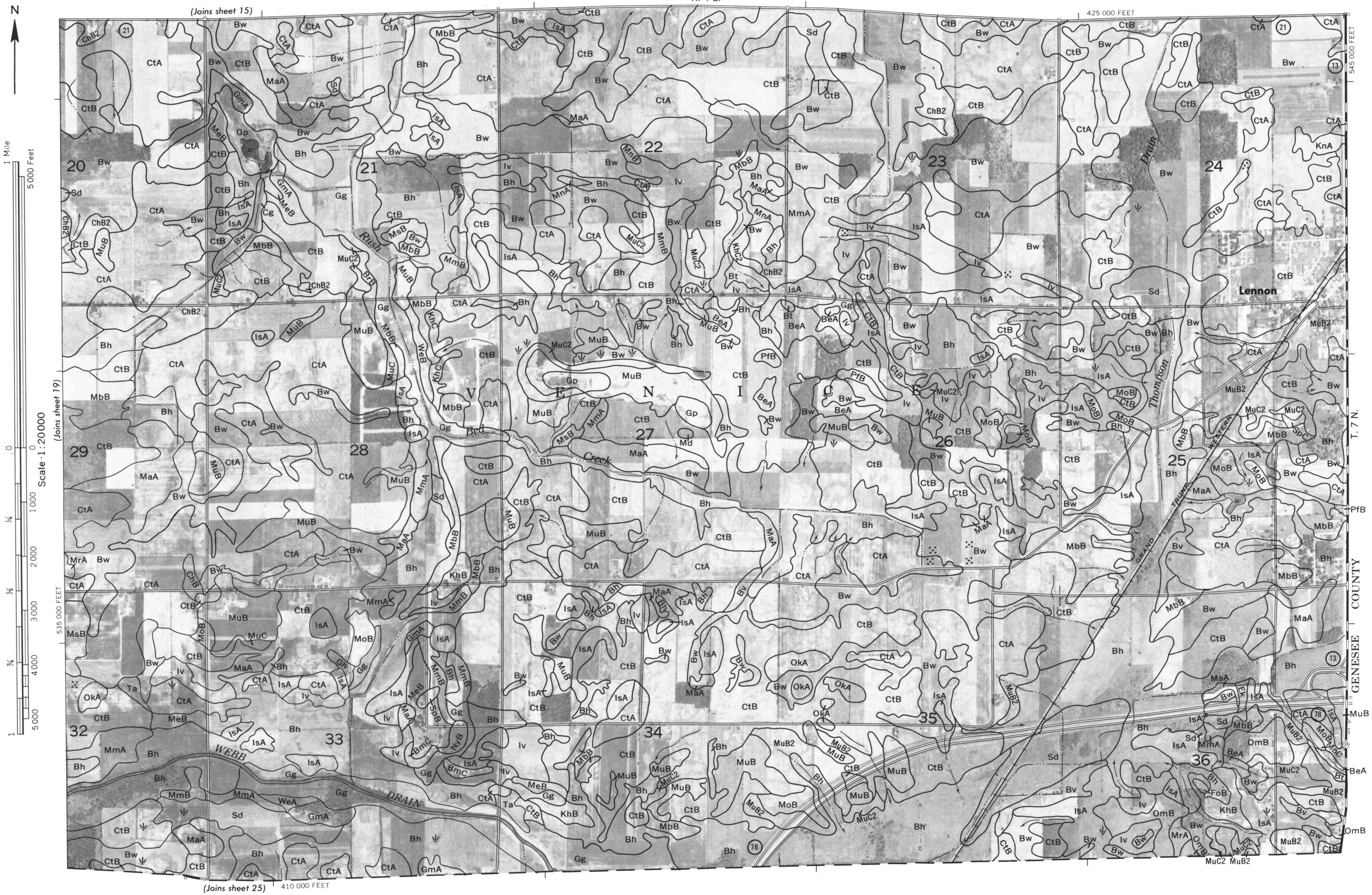
GRAND TRUNK WESTERN

WEBB DRAIN

1 Mile

5000 Feet

Scale · 1:20000



Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 21

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

315 000 FEET — R. 1 E. — (Joins sheet 16) | (17)

530 000 FEET

T. 6 N.

CLINTON COUNTY

(Joins sheet 22)

520 000 FEET

(Joins sheet 26)

335 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

22

N

R. 2 E.

T. 6 N.

(Joins sheet 21)

(Joins sheet 27)

(Joins sheet 17)

(sh18)

(Joins sheet 23)

355 000 FEET

340 000 FEET

520 000 FEET

530 000 FEET

Bennington

Manitou Lake

Bear Creek

MAPLE RIVER

Brook

Spring

CENTRAL PENN

BENNINGTON

1 Mile

5000 Feet

Scale 1:20000

Land division corners are approximately positioned on this map.

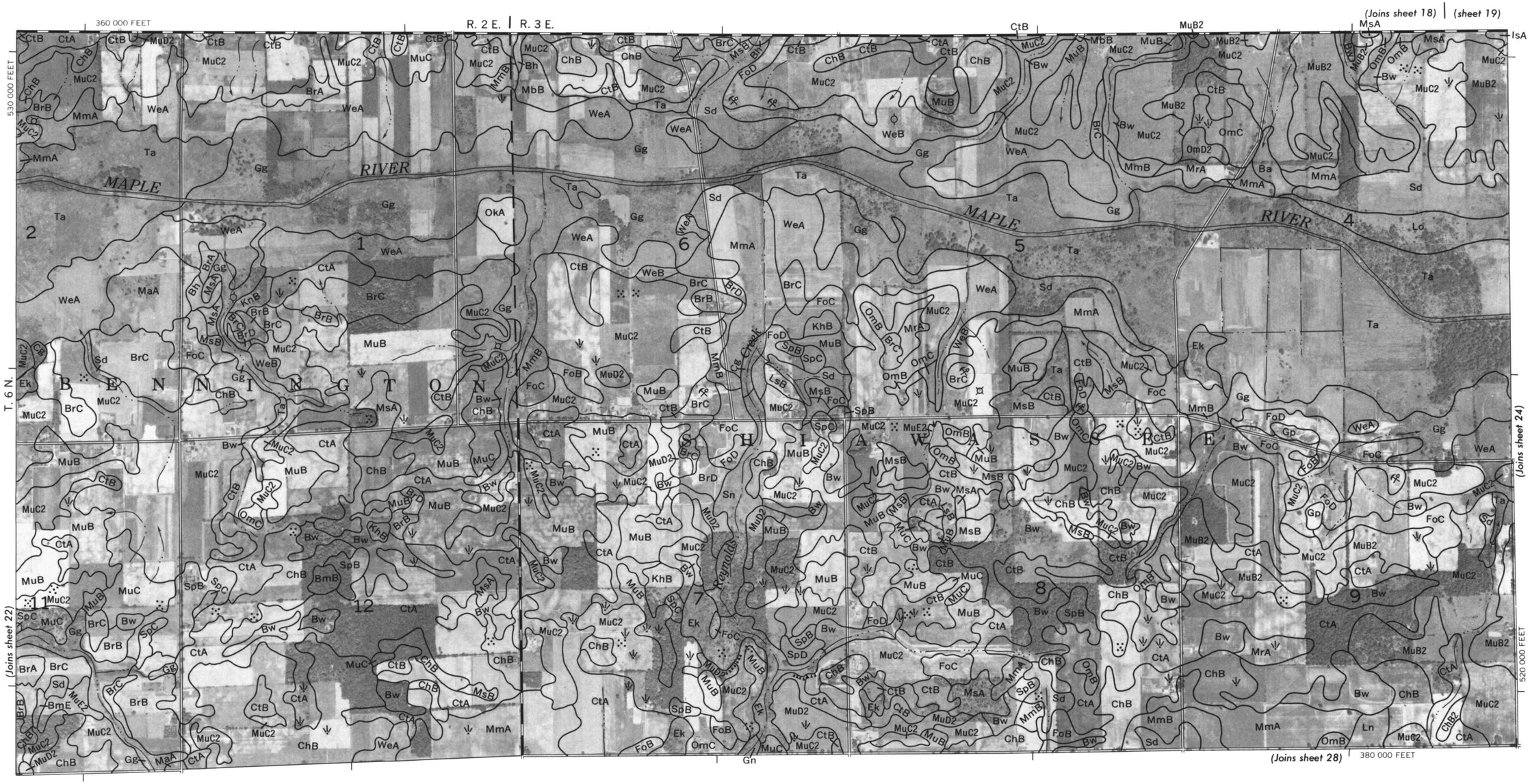
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 22

SHIAWASSEE COUNTY, MICHIGAN NO. 23

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.



24

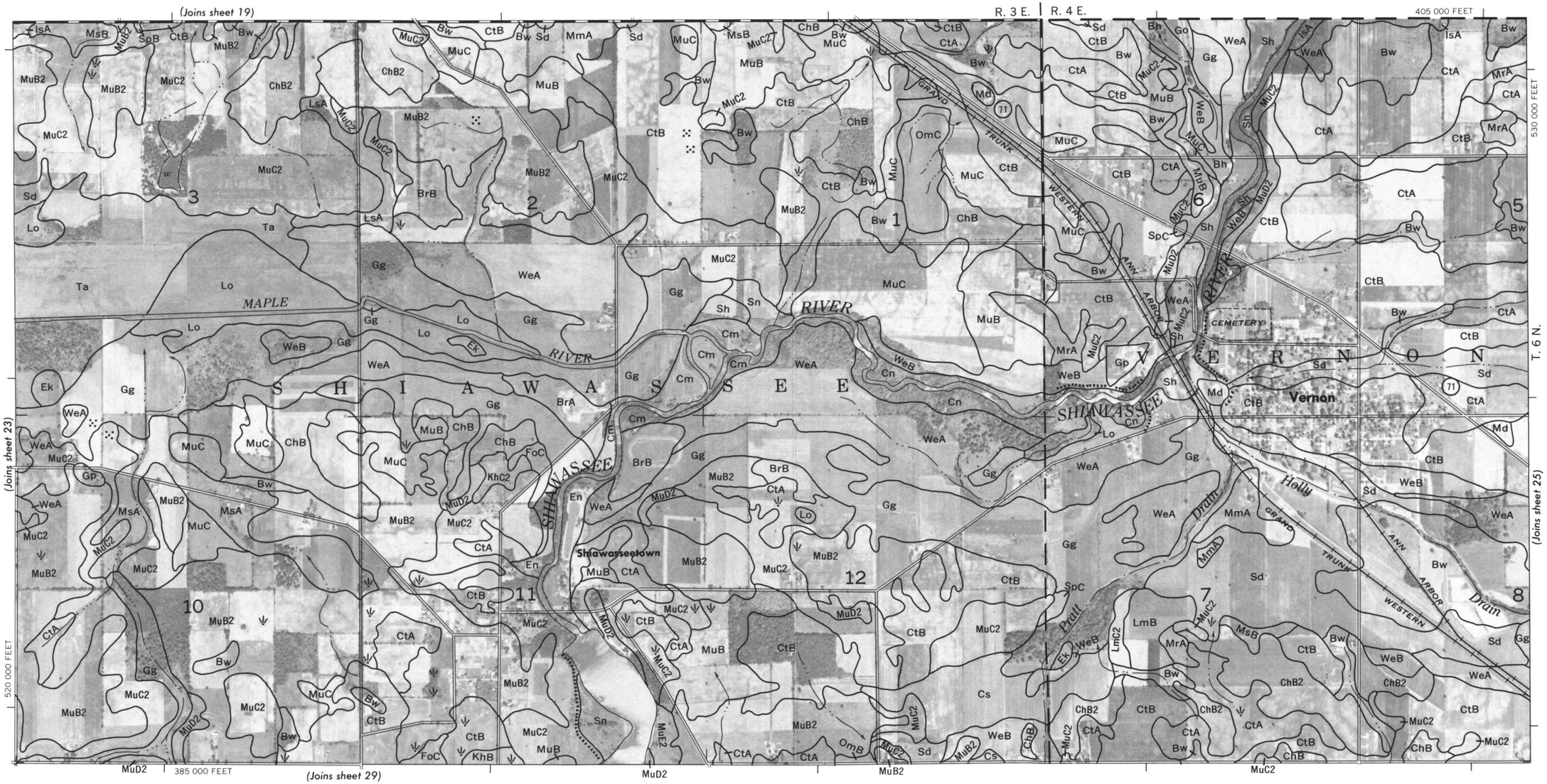
N

1 Mile 5000 Feet

Scale 1:20000

0 ¼ ½ ¾ 1

0 1000 2000 3000 4000 5000



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

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SHIAWASSEE COUNTY, MICHIGAN NO. 24

SHIAWASSEE COUNTY, MICHIGAN NO. 25

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

(19) (Joins sheet 20)

410 000 FEET

R. 4 E.

530 000 FEET

T. 6 N.

(Joins sheet 24)

(Joins sheet 30)

425 000 FEET

520 000 FEET

GENESEE COUNTY

WEBB DRAIN

WESTERN TRUNK GRAND TRUNK

Holly Drain

Mikan Drain

Drain

ANN ARBOR GTW

Chalker School

water

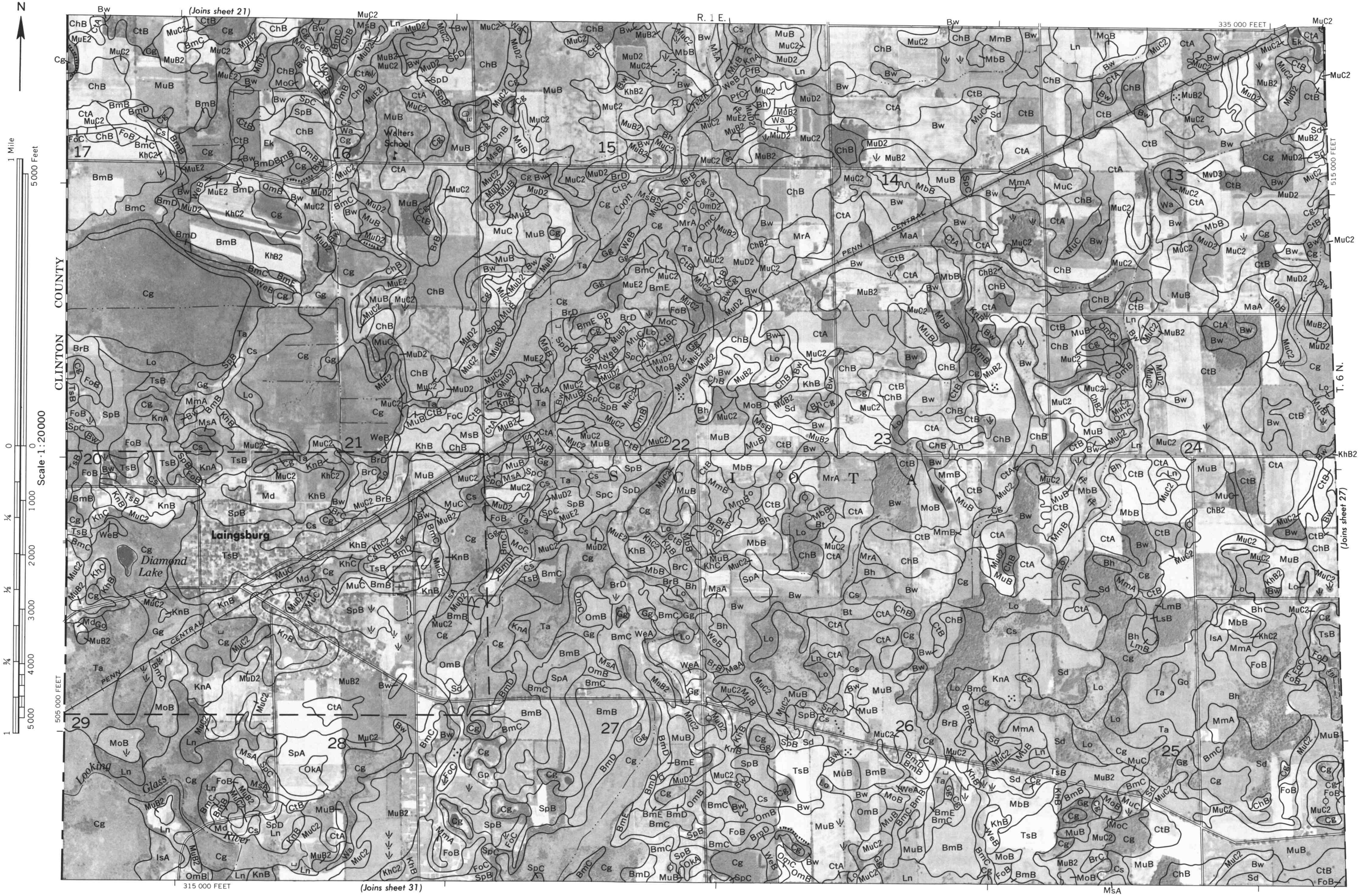
25

N

1 Mile

5000 Feet

Scale 1:20000



Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

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SHIAWASSEE COUNTY, MICHIGAN NO. 27

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

340 000 FEET

R. 2 E.

(Joins sheet 22)

515 000 FEET

T. 6 N.

(Joins sheet 26)

(Joins sheet 28)

(Joins sheet 32)

355 000 FEET

505 000 FEET

N

1 Mile

5,000 Feet

Scale 1:20000

28

N

R. 2 E. | R. 3 E.

T. 6 N.

(Joins sheet 23)

(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 33)

380 000 FEET

360 000 FEET

515 000 FEET

505 000 FEET

Scale 1:20000

1 Mile 5000 Feet

0 1000 2000 3000 4000 5000

BENNINGTON

SHIAWASSEE

Creek

Reynolds

Glass

Looking

River

Land division corners are approximately positioned on this map.

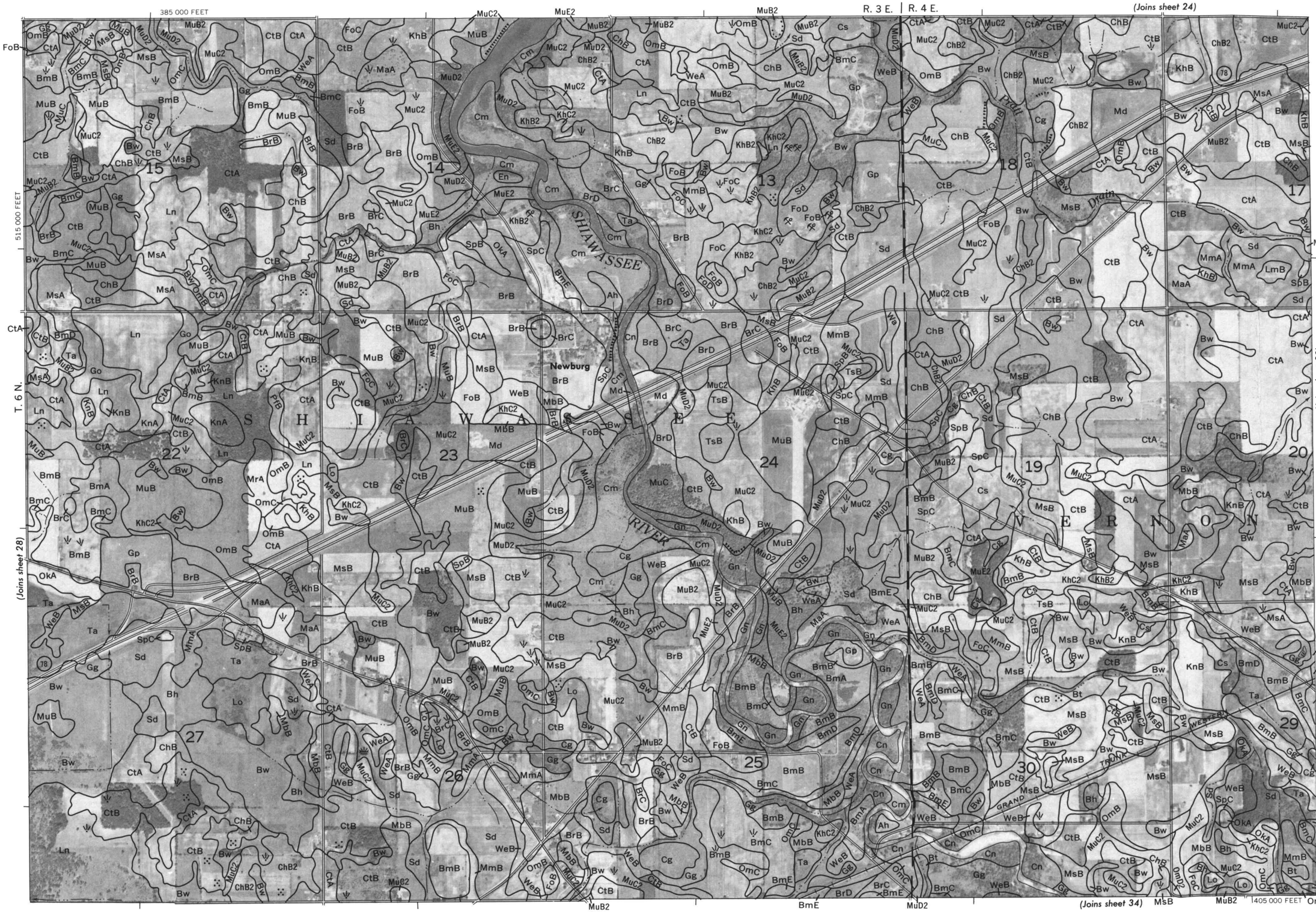
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 28

SHIAWASSEE COUNTY, MICHIGAN NO. 29

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.



N

R. 4 E.

T. 6 N.

425 000 FEET

515 000 FEET

505 000 FEET

410 000 FEET

(Joins sheet 25)

(Joins sheet 29)

(Joins sheet 35)

DURAND

WESTERN

GRAND TRUNK

ARBOR

Milkan Drain

Three Mile Creek

1 Mile

5000 Feet

0

Scale · 1:20000

1000 2000 3000 4000 5000

COUNTY

GENESEE

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 30

SHIAWASSEE COUNTY, MICHIGAN NO. 31

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

OmB 315 000 FEET R. 1 E. BmD OmC MuB TsB MoB MuB2 MsA (Joins sheet 26)

500 000 FEET

T. 5 N. | T. 6 N.

CLINTON COUNTY

I O T A

W O O D H U L L

Looking Glass River

Wolf Lake

Loon Lake

North Graham Lake

South Graham Lake

Dunn Lake

(Joins sheet 32)

(Joins sheet 36)

235 000 FEET

N

1 Mile

5000 Feet

Scale 1:20000

32

N

(Joins sheet 27)

R. 2 E.

355 000 FEET

500 000 FEET

T. 6 N.

T. 5 N.

BENNINGTON

Looking Glass River

Austin Creek

Austin Twin Lakes

Grouse Creek

31 32 33 34 35

6 5 4 3 2

7 8 9 10 11

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 37)

490 000 FEET

340 000 FEET

1 Mile

5000 Feet

Scale 1:20000

0 0

¼ 1 000

½ 2000

¾ 3000

1 4000

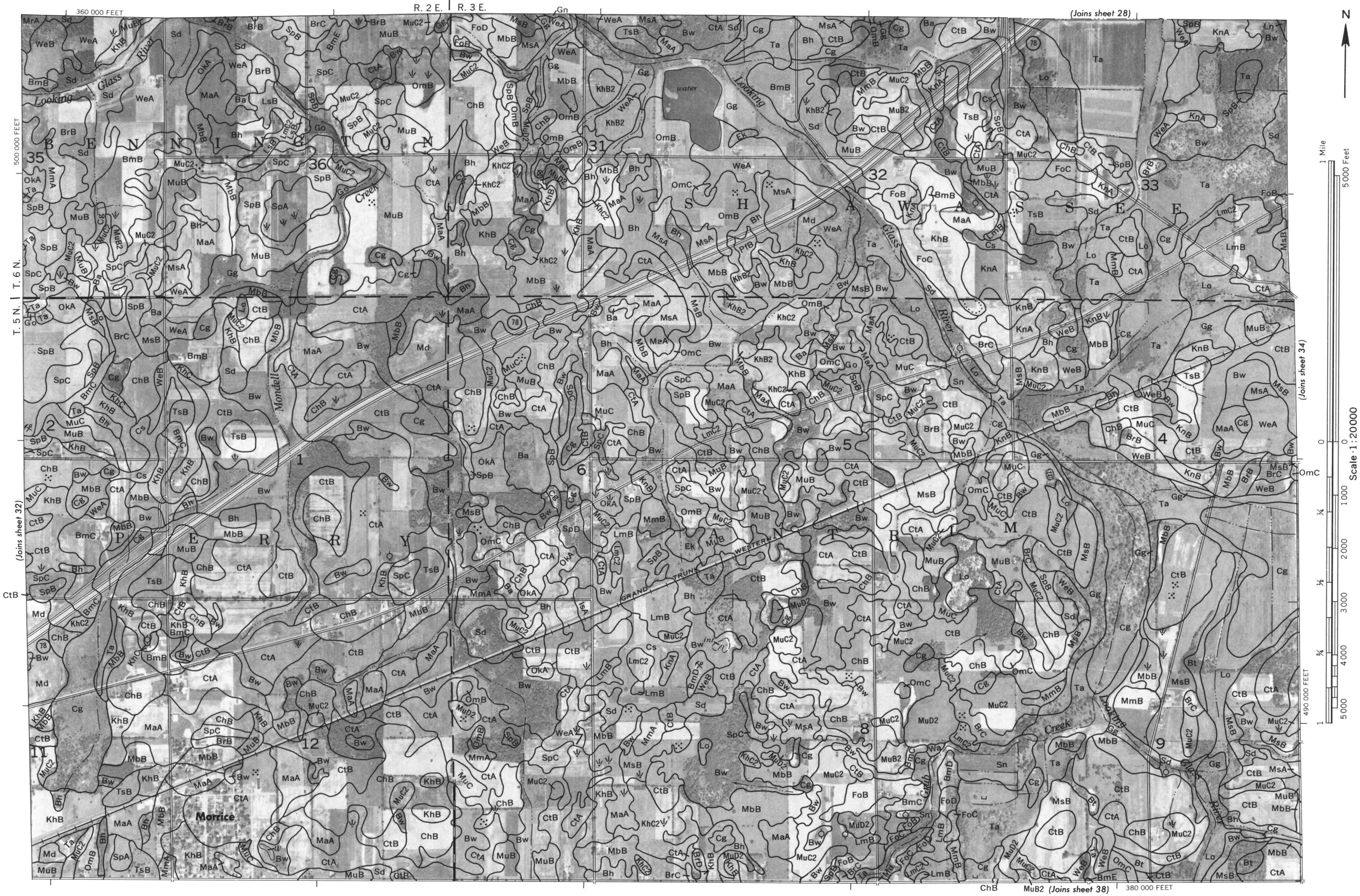
5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 32



SHIAWASSEE COUNTY, MICHIGAN NO. 33

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone. Land division corners are approximately positioned on this map.

34

N

1 Mile

5000 Feet

Scale 1:20000

(Joins sheet 29)

(Joins sheet 33)

(Joins sheet 39)

(Joins sheet 35)

405 000 FEET

500 000 FEET

490 000 FEET

385 000 FEET

R. 3 E. | R. 4 E.

T. 5 N. | T. 6 N.

Bancroft

SHIAWASSEE RIVER

Land division corners are approximately positioned on this map.

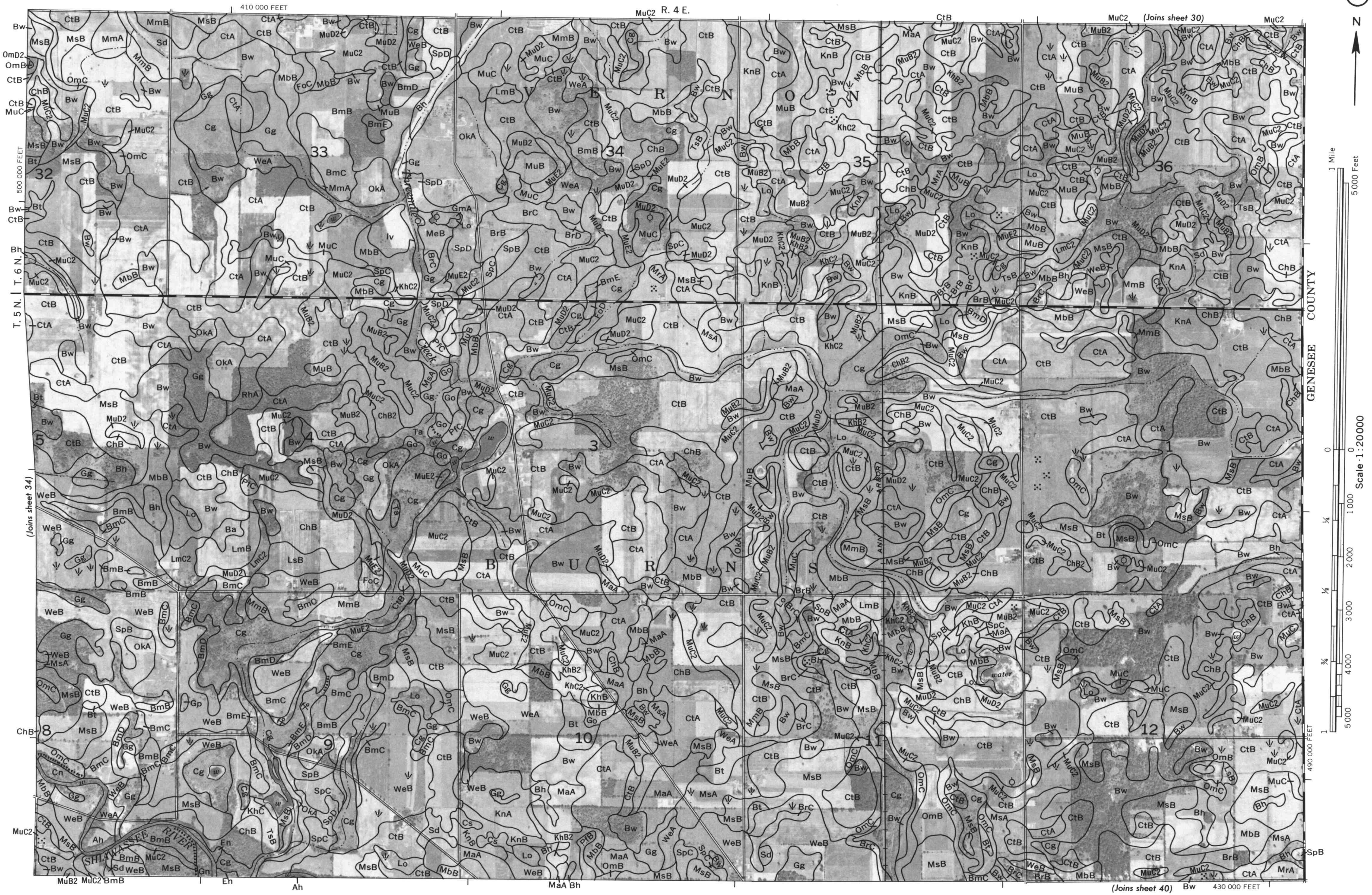
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 34

SHIAWASSEE COUNTY, MICHIGAN NO. 35

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone. Land division corners are approximately positioned on this map.



N

(Joins sheet 31)

R. 1 E.

335 000 FEET

485 000 FEET

CLINTON COUNTY

T. 5 N.

Dunn Lakes

Marsh Lake

Moon Lake

Colby Lake

Vermilion Creek

Shaftsburg

WESTERN TRUNK GRAND

water

(Joins sheet 37)

(Joins sheet 41)

315 000 FEET

475 000 FEET

1 Mile

5000 Feet

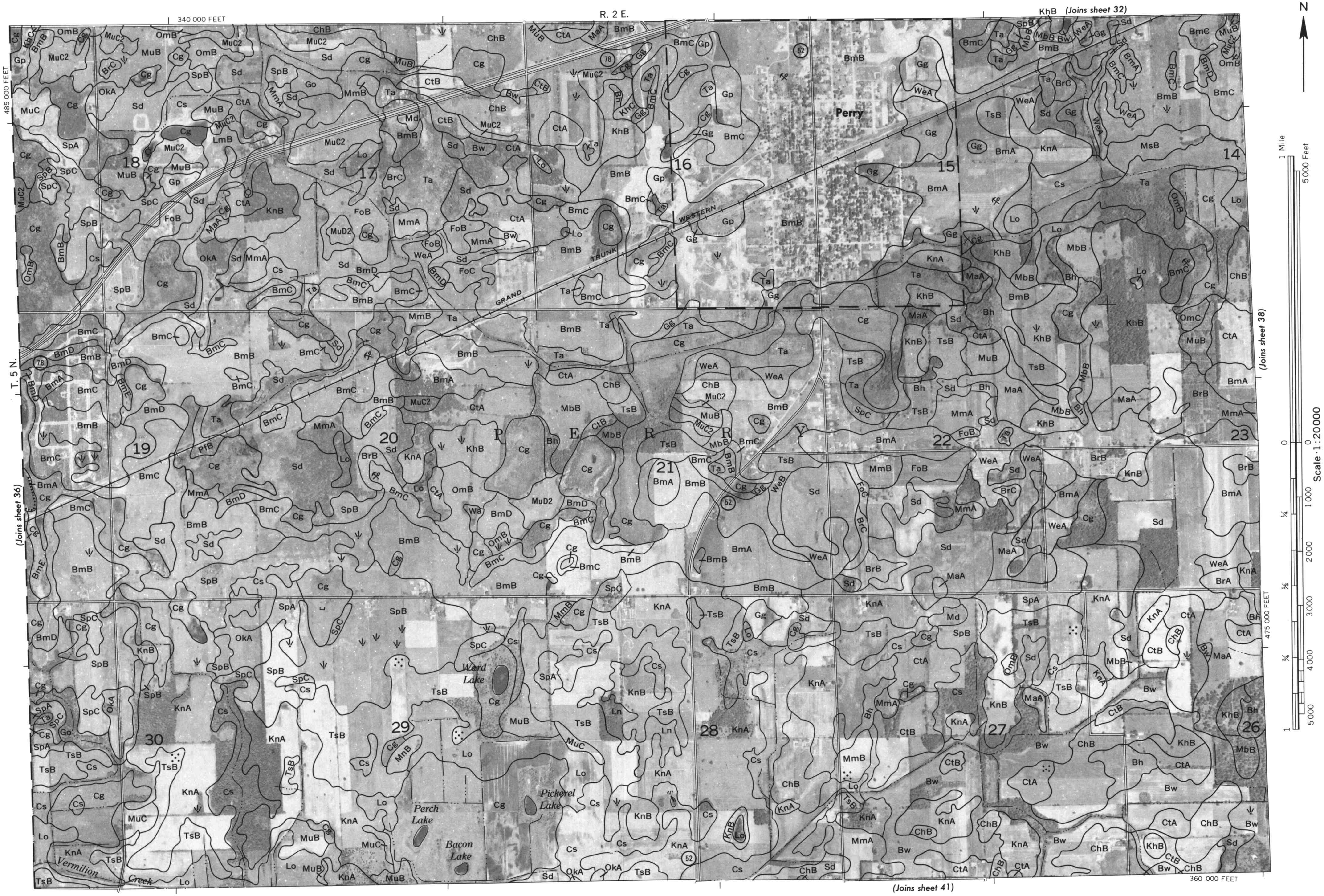
Scale 1:20000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 36



SHIAWASSEE COUNTY, MICHIGAN NO. 37

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station. Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone. Land division corners are approximately positioned on this map.

N

(Joins sheet 33)

R. 2 E. | R. 3 E.

380 000 FEET

485 000 FEET

T. 5 N.

(Joins sheet 37)

(Joins sheet 39)

(Joins sheet 42)

475 000 FEET

365 000 FEET

Morrice

Looking Glass River

Morgan Lakes

Hemingway Lake

Creek

RERRY

ANTRIM

1 Mile

5000 Feet

Scale · 1:20000

0 0

¼ 1000

½ 2000

¾ 3000

1 4000

5000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

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SHIAWASSEE COUNTY, MICHIGAN NO. 39

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

40

N

R. 4 E.

T. 5 N.

Cg SpC *(Joins sheet 35)*

430 000 FEET

485 000 FEET

475 000 FEET

410 000 FEET

(Joins sheet 39)

(Joins sheet 43)

1 Mile

5000 Feet

Scale 1:20000

0 0 ¼ 1000 ½ 2000 ¾ 4000 1 5000

SHIAWASSEE RIVER

BURNS

Byron

Shaw Lake

Butler Lake

Kanause Lake

Crystal Creek

ROWLEY CREEK

ARBOR ANN

SOUTH BRANCH

17 16 15 14 13 20 21 22 23 24 29 28 27 26 25

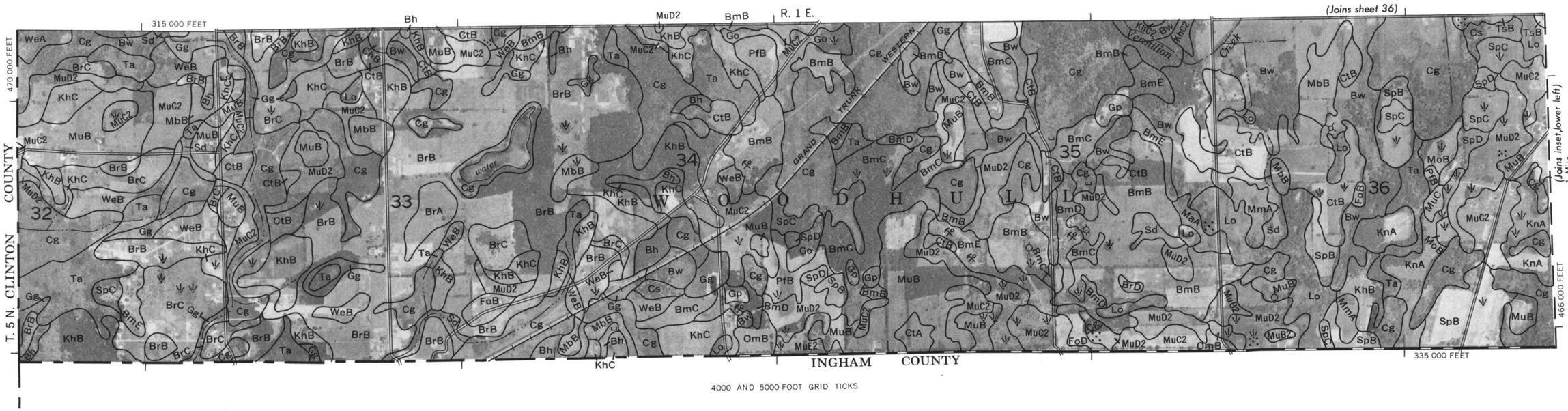
GENESEE COUNTY

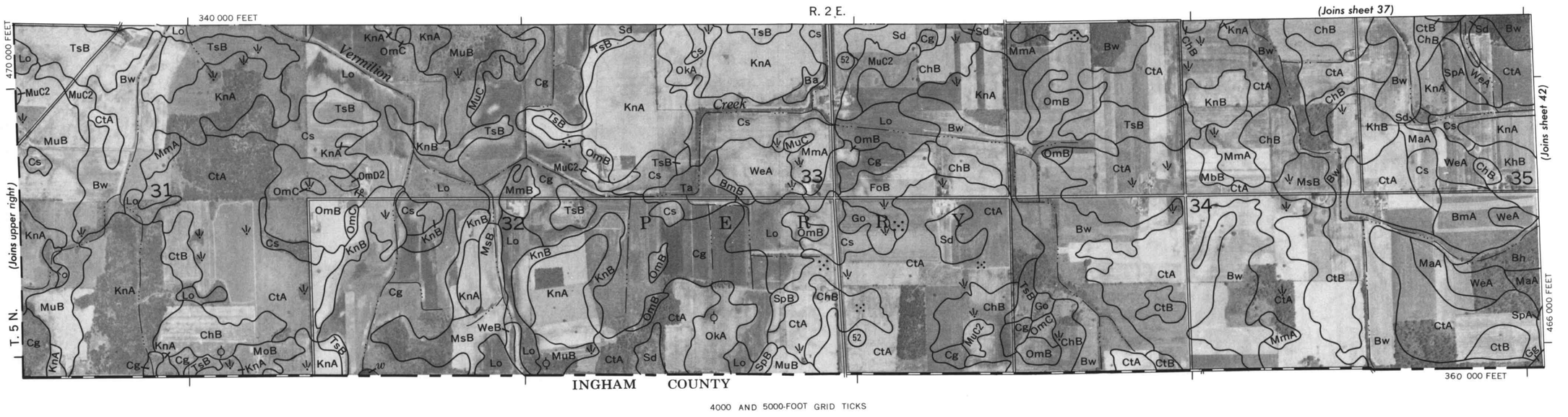
SHIAWASSEE COUNTY, MICHIGAN NO. 40

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.



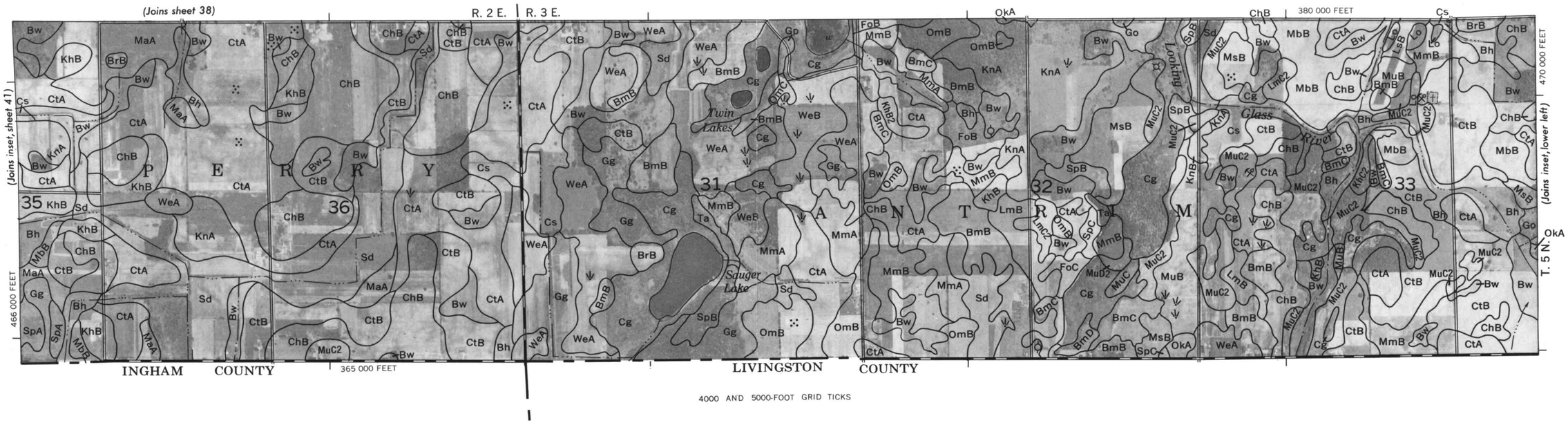


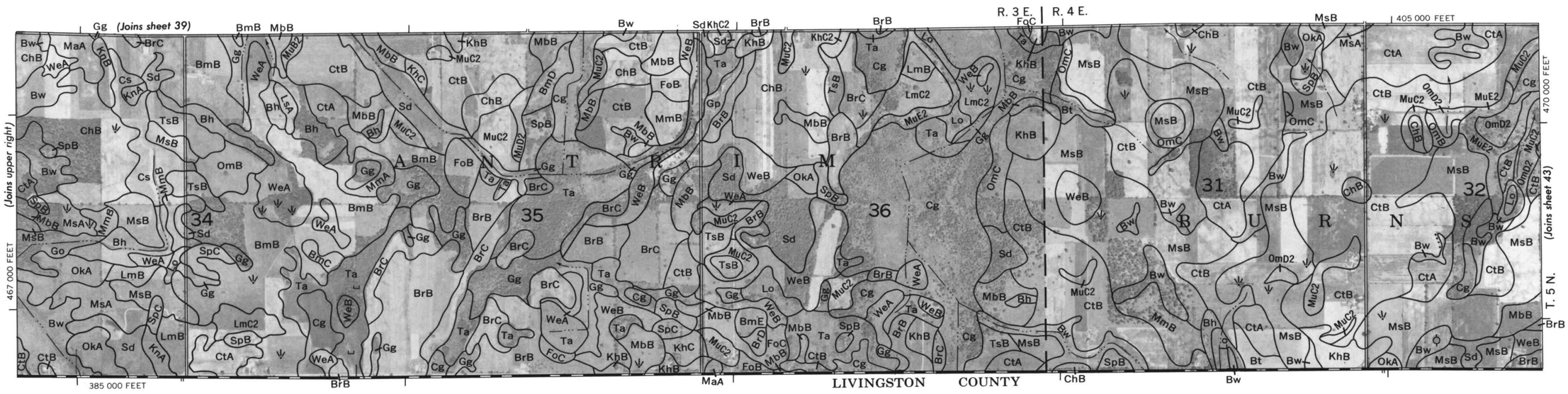
SHIAWASSEE COUNTY, MICHIGAN NO. 41

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.

42

N





1 Mile 5 000 Feet

Scale 1:20000

0 0

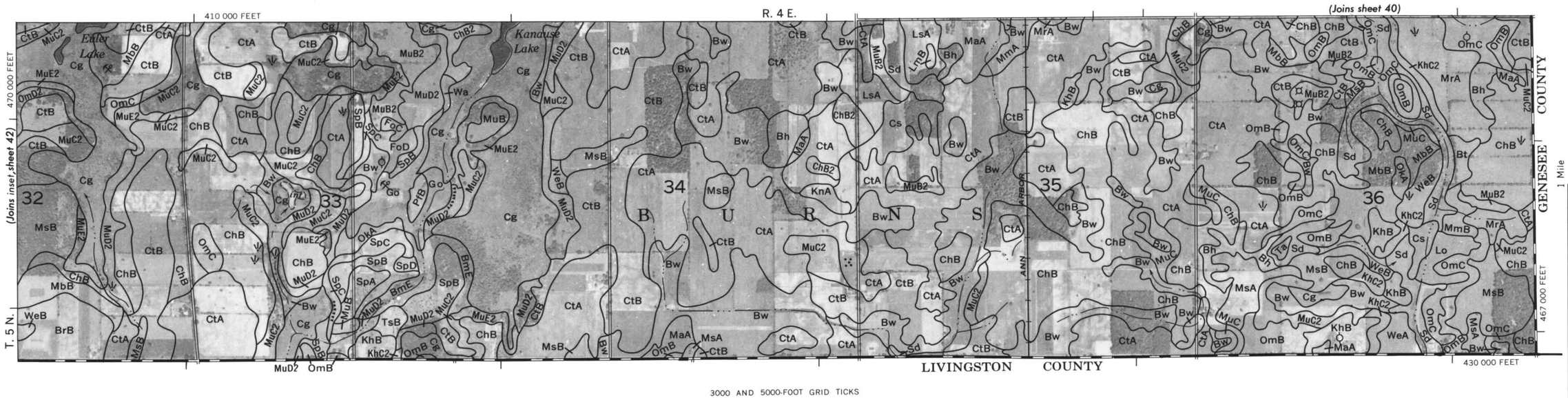
1 1/4 2 1/2 3 3/4 5 000 4 000 3 000 2 000 1 000

Land division corners are approximately positioned on this map.

Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.

SHIAWASSEE COUNTY, MICHIGAN NO. 42



SHIAWASSEE COUNTY, MICHIGAN NO. 43

This map is one of a set compiled in 1972 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Michigan Agricultural Experiment Station.
Photobase from 1970 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Michigan coordinate system, east zone.
Land division corners are approximately positioned on this map.